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August 31, 1988

Energy Research Abstracts

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ENERGY RESEARCH ABSTRACTS

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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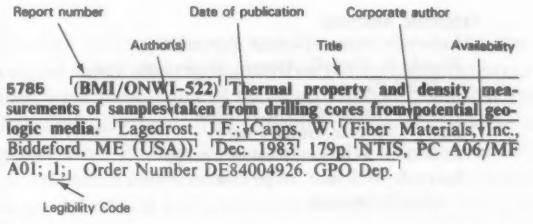
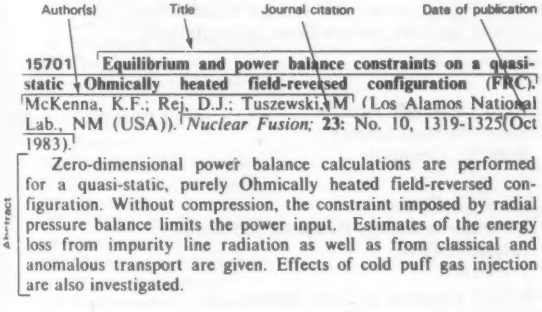
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23**: No. 10, 1319-1325 (Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
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• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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REVERSED-FIELD PINCH
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Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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IEA Biomass Conversion Service
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Commack, NY

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

35547 **(DOE/METC—88/6083) Technology transfer program at the Morgantown Energy Technology Center: FY 87 program report.** Brown, W.A.; Lessing, K.B. (USDOE Morgantown Energy Technology Center, WV). Oct 1987. 101p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88001005/JAW.

The Morgantown Energy Technology Center (METC), located in Morgantown, West Virginia, is an energy research center of the US Department of Energy's (DOE's) Office of Fossil Energy. The research and development work is different from research work conducted by other Government agencies. In DOE research, the Government is not the ultimate "customer" for the technologies developed; the "customer" is business and industry in the private sector. Thus, tehcnology transfer is a fundamental goal of the DOE. The mission of the Fossil Energy program is to enhance the use of the nations's fossil energy resources. METC's mission applies to certain technologies within the broad scope of technologies encompassed by the Office of Fossil Energy. The Government functions as an underwriter of risk and as a catalyst to stimulate the development of technologies and technical information that might otherwise proceed at a slower pace because of the high-risk nature of the research involved. The research programs and priorities are industry driven; the purpose is to address the perceived needs of industry such that industry will ultimately bring the technologies to the commercial market. As evidenced in this report, METC has an active and effective technology transfer program that is incorporated into all aspects of project planning and execution. Technology transfer at METC is a way of life—a part of everyday activities to further this goal. Each person has a charge to communicate the ideas from within METC to those best able to utilize that information. 4 figs., 20 tabs.

0103 Preparation

REFER ALSO TO CITATION(S) 35582, 35585, 35640

35548 **(DOE/PC/79919—2) Flotation and flocculation chemistry of coal and oxidized coals: Technical progress report, December 15, 1987 to March 15, 1988.** Somasundaran, P. (Columbia Univ., New York (USA)). 1988. Contract FG22-87PC79919. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011158/JAW.

The results of film flotation are shown in Fig. (3). Film, flotation gives information analogous to the Tromp curve in float sink experiments. It has been established by Fuerstenau and co-workers that the results of film flotation are dependent on the surface characteristics of the coal. This curve is also analogous to the Zisman plot of cos O vs surface tension of a homologous series of liquids used for measuring the respective contact angles. Points on the film flotation curve represent the critical wetting surface tension of various moieties on the surface of coal. Analysis of results of Film flotation of base coal and PAM treated coal show that increase in PAM concentration renders the coal surface more hydrophilic. Different moieties on the coal surface adsorb PAM to different extents. At around 32% to 40% methanol it is observed that adsorption of PAM in the concentration range 7 to 14 ppM is reversed resulting in a relatively more hydrophobic surface. It is proposed to refine the film flotation technique as a method to study the nature of adsorption of various reagents proposed. This is essential since this technique enables the study of the effect of heterogeneity on various surface interactions. Experiments are also planned to investigate if the response to Film flotation characterizes the total surface or the surface of an individual particle. 6 refs., 3 figs.

35549 **(ORNL—6459) Impact of biotechnology on coal processing.** Lee, D.D.; Scott, C.D. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 71p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011234/JAW.

There is increasing interest in the application of biotechnology to the coal industry. The bioprocessing systems that have been proposed or that can be envisioned for the future involve all aspects of coal utilization. These include beneficiation of coal for the removal of sulfur and other heteroatoms, modification of coal properties, solubilization or liquefaction of coal, conversion of by-product gases to liquid fuel, single- or two-stage microbial gasification, in situ processing of coal, liquid products upgrading by heteroatom removal, wastewater treatment to remove organics and inorganics, heavy metal removal from wastewater, heteroatom removal from gaseous products or off-gas by immobilized microorganisms, stabilization of coal processing residues, and product spill cleanup. It was found that the only areas where considerable research has been done are in wastewater treatment and pyrite removal. The other areas have not been studied in enough detail to provide adequate information for even preliminary process designs, and, in some cases, the proposed applications are entirely speculative. Much additional research and development will be required before proper process considerations can be made, but the potential benefits would be well worth the effort. 228 refs., 7 tabs.

35550 **(STEV-TORV—88-2) Polyelectrolytes and dewatering of peat.** Alden, L. (Statens Energiverk, Stockholm (Sweden)). Sep 1987. 35p. (In Swedish and English). NTIS (US Sales Only), PC A03. Order Number DE88752969/JAW.

The success of artificial mechanical peat dewatering depends mainly on the behaviour of suspended particles in the peat. The suspended particles less than 10 /my/m are transported with the water and will clog the drainage passages. Polyelectrolytes, which bind the peat particles to larger aggregates and form a porous structure, enhance the dewaterability drastically. Surface load, wire cloth size, pressure application, start moisture content and predrainage have a crucial impact on the result. The relation between these factors are not satisfactory examined. These factors need to be further investigated in order to establish a good dewatering process design. The pressure application should be performed first by a low pressure step to reach a dry solid content of 15-18% followed by a high pressure step. Both cationic and anionic polyelectrolytes increase the dewatering rate substantially in particular for highly humified peat. The cost of polyelectrolyte treatment is 3-8 USD/ton dry peat.

35551 **(VTT-TUTK—494) Artificial dewatering of peat. Part 2. The structure of Finnish peat and its influence on water retention.** Aho, M.; Laiho, R.; Tummavuori, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1987. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752875/JAW.

The water binding properties of peat were studied with six peat samples from two peat production areas in Finland. The samples represented the two main types of Finnish peat, Sphagnum and Cares. The degree of humification varied. The most important physical and chemical properties and the water binding properties of the samples were measured and compared. Several different methods of analyzing peat were evaluated during the course of the study. The water retention capacities measured for the samples varied strongly with the dewatering procedure. For example, despite the large water retention capacity measured for the ErS peat in matric suction experiments, it was dried more effectively than the other ErS peats by pressing. A direct connection between

water retention capacity and the physical and chemical properties was thus difficult to establish. Pressing without the addition of a flocculant was the most effective dewatering method for low-humified peats with large mean particle size and low carbon content. The effect of pressing on Sphagnum peat samples could be predicted from the infrared spectra. Medium and highly humified peats were more effectively dried by water suction suggesting that the methods may complement each other. If a flocculant is not used, water suction drying would seem to give slightly higher dry peat contents than pressing. Thermal drying experiments involving low-temperature thermogravimetry revealed that the direct water binding forces in the samples did not differ appreciably in the range 10-50% dry peat per weight. However, pressing reduced the water binding forces, showing that differences in water binding properties are mainly attributable to structural factors, such as particle size distribution and porosity. On the whole, Carex peats were more easily dewatered than Sphagnum peats.

35552 **(VTT-TUTK—501) Artificial dewatering of peat. Mechanical dewatering.** Pirkkonen, P.; Luukkainen, V-M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1987. 144p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753002/JAW.

The capability of a screen belt press to remove water especially from Finnish well decomposed peat was researched in this study. The most important result was obtained when well decomposed peat fed as slurry was dewatered by a production scale mechanical screen belt press to a moisture content of 30%. The capacity of the press was 400 kg DS/hm. This result was obtained by combining several treatments which promote water release. The most important treatments were the use of a thick slurry (dry solid content >10%), the use of an anionic flocculation chemical (dosage <1 kg/t dry solids) and the preheating of the slurry. It is possible to obtain an even higher capacity without decreasing the dry solid content of the pressing cake because the velocity of the belt was only 5 m/min. It already approached a commercially profitable pressing process. A dry solid content of 35% was obtained by a high pressure production scale screen belt press but the capacity remained at 300 kg DS/hm due to damage to the device. The water release from peat can be promoted by large particle size of peat, feeding of peat without slurrying, control of acidity of peat, peat freeze-thaw treated, long pressing time, pressing cake is crushed, slurry is predewatered by a suction system. The effects of these factors have been illustrated in the literature review, where the devices used in the mechanical dewatering of peat are also presented. The experimental part presents the results of pressing trials, carried out both by a laboratory scale piston press and by production scale screen belt presses. Viable treatments of finnish peat for belt presses were sought for using piston pressing. A combination of several treatments in order to promote water release from peat were studied for the first time in Finland in runs on a production scale.

35553 **Selective flocculation of fine coal.** Krishnan, S.V. (Battelle Labs., Columbus, OH (US)). pp 160-178 of Fine coal processing. Mishra, S.K.; Klimpel, R.R. Park Ridge, NJ; Noyes Publications (1987).

Coal currently represents one of the largest energy resources in the world. If properly prepared it may be utilized to reduce dependence on oil and lower total energy costs. Historically, coal has been cleaned by separating the carbonaceous fraction from the ash-forming mineral matter (including pyrite) by gravity-based methods and/or flotation. However, deashing of coal by these physical methods is limited. The ash components must be liberated from the coal prior to separation. High ash removal levels require fine (minus 48 mesh) to ultrafine (minus 200 mesh) grinding. Conventional and advanced physical beneficiation processes are, generally, inefficient in terms of Btu recovery, or too expensive for use with ultrafine coal. An effective and inexpensive process in needed for cleanup of fine and ultrafine coals. The need for cleaning and recovery of fine and ultrafine coal fractions has increased in recent years. This results from a desire to replace oil by very low ash, coal-water mixtures (CWMs[, to improve the overall Btu recovery of preparation plants, to reduce the environmental concerns associated with burning coal, and recover coal values traditionally lost with coal wastes. An advanced physical separation technique that appears to economically address the current need is selective flocculation. This technique is being increasingly recognized as one of the more promising new separation technologies for the processing of fine and ultrafine materials. Selective flocculation makes use of the differences in the surface chemical characteristics of the coal and the ash mineral particles, bringing about a separation between the two types of materials with the aid of selective polymeric flocculants. This chapter examines the fundamentals of the selective flocculation process and discusses the results of some of the relevant studies that have been carried out to date.

35554 **Oil agglomeration process for the treatment of fine coal.** Steedman, W.G.; Krishnan, S.V. (Battelle Labs., Columbus, OH (US)). pp 179-204 of Fine coal processing. Mishra, S.K.; Klimpel, R.R. Park Ridge, NJ; Noyes Publications (1987).

Fine particles in liquid suspension can be agglomerated and recovered in a number of ways. The use of electrolytes to reduce the zeta potential, thereby allowing colliding particles to cohere, and the use of polymeric flocculants to bridge between particles are two such methods. A third method, and the subject of this chapter, is the addition of an immiscible liquid to the suspension to cause adhesion of the particles by capillary interfacial forces. Typically, the immiscible liquid used is an oil; the technique is therefore known as oil agglomeration or selective oil agglomeration. Oil agglomeration relies upon differences in the surface properties of the organic and inorganic particles to effect separation. The carbonaceous constituent of fine coals can be agglomerated from aqueous suspensions using a wide variety of oils as the collecting liquid. Inorganic constituents normally remain in suspension and are rejected. The technique is well-suited for the processing of fine coal because its performance does not diminish with extremely fine coals as does froth flotation. The technique also can be used successfully in the presence of clay slimes. This chapter presents the principles and process description of oil agglomeration, and discusses the impact of important process variables on its performance. Also included is an overview of past and current applications of the technique and a discussion of process economics.

0104 Processing

REFER ALSO TO CITATION(S) 35549, 35584, 35588, 35625, 35638, 35700, 35700, 35997, 35998, 37290, 37290

35555 **(BNL—40900) Enhancement of coal quality by microbial demetalization and desulfurization.** Olson, L.J.; Chetty, A.; Chhabria, S.P.; Karohl, D.A. (Massachusetts Inst. of Tech., Brookhaven, NY (USA). School of Chemical Engineering Practice-Brookhaven Station). May 1986. Contract AC02-76CH00016. 100p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88008835/JAW.

The removal of metals from coal improves quality by reducing the ash content and possibly altering the ash fusion temperature, which reduces fouling of combustion equipment. This study characterized the demetallization and desulfurization of coal catalyzed by the bacterium Thiobacillus ferrooxidans, and estimated the economic feasibility of a commercial-scale microbial coal-benefication process. The effects of slurry concentration, coal type, particle size, temperature, degree of agitation, nutrient concentration, and CO_2 concentration on the rate and extent of metal and sulfur solubilization by Thiobacillus ferrooxidans were investigated in lab-scale batch experiments. Thiobacillus ferrooxidans greatly enhanced the extent of sulfur and iron leaching from the three coals tested, slightly enhanced aluminum leaching, but did not improve the leaching of Mg, Na, or Ca. The fractional amount of each metal removed increased with decreasing slurry concentration, perhaps due to insufficient mixing by the mechanical shakers. After 16 days, the maximum amount of inorganic sulfur removed was 79% while the maximum amount of iron removed was 45%. Ash content was reduced significantly for all three coals tested. Pittsburgh coal displayed a 27% reduction in ash content with bacteria present. The hemispherical ash fusion temperature increased between 150 F and 450F due to bacterial leaching for two types of coal. The proposed coal benefication process, to be located at a new 500-MW utility in Ohio, incorporates a 20% slurry and achieves 90% inorganic sulfur removal. An estimated total capital cost of $27 million and an estimated operating cost of $26 million per year yield a total cost of

$9.58ton of coal treated. This total cost is highly sensitive to the annual operating cost and compares favorably with other proposed coal desulfurization processes. 26 refs., 21 figs., 36 tabs.

35556 **(CONF-880770—1-Draft) Conversion of coal to liquids and gases by advanced bioprocessing systems.** Scott, C.D.; Faison, B.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011829/JAW.

From Coal - targets of opportunity workshop; Washington, DC, USA (12 Jul 1988).

A bioprocess can be defined as the directed and controlled use of living organisms or their products to bring about desired chemical and/or physical change. Because of their specificity, bioprocesses can be used to separate a product or contaminant from mixtures or to convert a component of a mixture to a useful product at mild operating conditions. There are an increasing number of concepts that are being considered for use in the processing of fossil fuels, particularly for coal. These include coal preparation technologies such as beneficiation; conversion of coal to useful liquid or gaseous products; product upgrading with removal of detrimental and hazardous components; and environmental control technology for gaseous, liquid, and solid effluents. The conversion of coal to liquids and gases is of specific interest, since the mild operating conditions of biological processes would be very attractive when compared to the rather severe chemical and physical process environment needed for the thermal/chemical conversion of coal. Research results on the biological conversion of coal are summarized and the potential impact of this evolving technology is assessed.

35557 **(CRIE-T—86082) Evaluation of creep-fatigue strength properties of a single crystal superalloy.** Matsubara, Masaaki; Nitta, Akihito. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1987. 30p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752535/JAW.

For an increase in the efficiency of gas-steam combined cycle power plants, it is necessary to develop high-strength, heat-resistant alloys to be used as material for high-temperature apparatus including stationary and moving blades for gas turbines. Under such circumstances, attention is currently focused on single crystal superalloys. This report deals with a study on high-temperature properties of a single crystal superalloy, which represent an important factor in developing practical material. The dependence of creep rupture strength on crystal structure is investigated in detail. A fatigue test under continuous tensile stress shows that the failure life decreases with increasing stress application time. The failure life does not vary with strain profile when the frequency is the same. Under controlled stress, the high-temperature fatigue strength is found to depend on the crystallographic orientation. It is also be found that the damage to the surface of fatigue test samples is affected by the strain profile and that secondary dendrites have effects on the fatigue strength. (25 figs, 5 tabs, 5 refs)

35558 **(DOE/MC—23075-2555) Measurement and modeling of advanced coal conversion: 5th quarterly report, October 1, 1987 to December 31, 1987.** Solomon, P.R.; Hamblen, D.G.; Serio, M.A.; Smoot, L.D.; Brewster, S. (Advanced Fuel Research, Inc., East Hartford, CT (USA); Brigham Young Univ., Provo, UT (USA)). Mar 1988. Contract AC21-86MC23075. 183p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88001057/JAW.

The overall objective of this program is the development of predictive capability for the design, scale up, simulation, control and feedstock evaluation in advanced coal conversion devices. This technology is important to reduce the technical and economic risks inherent in utilizing coal, a feedstock whose variable and often unexpected behavior presents a significant challenge. This program will merge significant advances made at Advanced Fuel Research, Inc. (AFR) in measuring and quantitatively describing the mechanisms in coal conversion behavior, with technology being developed at Brigham Young University (BYU) in comprehensive computer codes for mechanistic modeling of entrained-bed gasification. Additional capabilities in predicting pollutant formaton will be implemented and the technology will be expanded to fixed-bed reactors. The foundation to describe coal-specific conversion behavior will be AFR's Functinal Group (FG) and Devolatilization, Vaporization, and Crosslinking (DVC) models have demonstrated under previous and on-going METC sponsored programs. These models have demonstrated the capability to describe the time dependent evolution of individual gas species, and the amount and characteristics of tar and char. The FG/DC models will be integrated with BYU's comprehensive two-dimensional reactor model, PCGC-2, which is currently the most widely used reactor simulation for combustion or gasification. The program includes: (1) validation of the submodels by comparison with laboratory data obtained in this program, (2) extensive validation of the modified comprehensive code by comparison of predicted results with data from bench-scale and process scale investigations of gasification, mild gasification and combustion of coal or coal-derived products in heat engines, and (3) development of well documented user friendly software applicable to a "workstation" environment.

35559 **(DOE/MC/21063—2567) A 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized bed gasification system: Quarterly report, October 1-December 31, 1984.** (KRW Energy Systems, Inc., Madison, PA (USA)). Aug 1987. Contract AC21-84MC21063. 130p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88001066/JAW.

Technology development at the Process Development Unit (PDU) in Waltz Mill, PA, has shown that the pressurized, ash-agglomerating fluidized-bed coal gasification process developed by KRW Energy Systems Inc. is an economically attractive coal conversion technology. Long duration testing has demonstrated high carbon conversion, and extensive environmental characterization of PDU effluents has shown that all PDU wastes can be economically and safely disposed. This fluidized-bed technology has been evaluated in the PDU, having a nominal air-blown feed rate of 15 tons per day, and in a full scale cold model to provide the necessary design models and scaleup design correlations. The KRW technology serves as the foundation for the current DOE development contract which focuses on hot gas cleanup and combined cycle generation and provides for the development of two complementary and novel hot gas cleanup technologies: in-bed desulfurization and external desulfurization. The DOE Morgantown Energy Technology Center (METC) pioneered the development of the external desulfurization process which is now being scaled for demonstration at the PDU. External hot gas cleanup design work is underway at KRW as discussed in Section 3.0. Testing at the PDU continued with completion of mechanistic test TP-035-5 in December 1984, which commissioned a two-stage L-valve fines recycle configuration with a tertiary non-recycle cyclone downstream. An assessment on the design basis for a multiple-jet configuration in the KRW cold flow scaleup facility (CFSF) and large-scale commercial units was completed and is presented herein. 67 refs., 32 figs., 14 tabs.

35560 **(DOE/MC/21063—2571) A 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized bed gasification system: Quarterly report, April 1-June 30, 1985.** (KRW Energy Systems, Inc., Madison, PA (USA)). Feb 1988. Contract AC21-84MC21063. 118p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88001073/JAW.

The design report for the KRW external hot gas cleanup system is in progress. The second air-blown gasifier PDU test for evaluation of in-bed desulfurization was completed. Gasifier operability with in-bed desulfurization was demonstrated by successful operation of the PDU. This success was attributed to improved operation of the dolomite feeder, operational flexibility of the modified ash annulus gas distributors, and specific gasifier startup and transition strategies. The solid wastes discharged from the PDU gasifier during in-bed desulfurization testing include a mixture of agglomerate ash and spent sorbent. The spent sorbent (calcium sulfide) can be converted to calcium sulfate during the in-bed desulfurization process. This is a chemical reaction which minimizes the reactive waste's hazardous properties. Disposal studies and characterization of the PDU reactive wastes were initiated. In addition, process performance was analyzed in terms of gasification rate and

product gas composition for selected PDU tests. Work continued to develop process models to enhance predictions of gasifier performance. An evaluation of PDU test data (1983 to 1985) is in progress to compare PDU fines collection and recycle performance based on isokinetic solids measurements versus predicted values. Preliminary results suggest that further reductions in fines loss can be achieved at the PDU by modifying the geometry of the secondary cyclone.

35561 **(DOE/MC/21063—2572) A 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized bed gasification system: Quarterly report, April 1-June 30, 1986.** (KRW Energy Systems, Inc., Madison, PA (USA)). Feb 1988. Contract AC21-84MC21063. 131p. NTIS, PC A07;3. Order Number DE88001074/JAW.

The scope of work at KRW Energy Systems, Inc. (KRW) under the current contract consists, in part, of designing and installing an external hot gas cleanup system for testing in the Process Development Unit (PDU) at Waltz Mill, PA. This system comprises an external fixed-bed desulfurizer of zinc ferrite sorbent with a sintered metal filter system and associated hot piping and instrumentation. Document FE-21063-40 reports progress on PDU modifications completed on the external hot gas cleanup system (HGCU), and it specifically discusses the safety reviews and safety issues completed for this system. Zinc ferrite sorbent was procured, received and loaded into the fixed-bed desulfurizer. The sintered metal filter was successfully tested in the PDU for 230 hours with no operational upsets during in-bed desulfurization test, TP-036-5. These test results are reported herein, along with metallographic analyses from the Argonne National Laboratory on the failed filter elements retrieved from PDU test TP-036-4. PDU modifications, a test summary, test accomplishments, and set point data for test TP-036-5 are reported as part of the Advanced In-Bed Gas Cleanup Program under the contract. Process analyses continued on analyzing existing data for inclusion in the mechanistic gasifier model to enable improved prediction of gasifier performance. Fines recycle analyses also continued to better understand fines loss and fines elutriation and enable evaluation of cyclone performance. Advanced system design work was completed on regenerated sulfur dioxide, external sulfation, and advanced instrumentation for the External Hot Gas Cleanup Program.

35562 **(DOE/MC/21063—2577) A 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized bed gasification system: Quarterly report, July 1-September 30, 1985.** Cherish, P.; Haldipur, G.B.; Lewandowski, D.; Lucas, J.L.; Katta, S.; Kim, S.S.; Kettering, E. (KRW Energy Systems, Inc., Madison, PA (USA)). Jan 1988. Contract AC21-84MC21063. 190p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88001082/JAW.

KRW Energy Systems Inc. completed installations of its external hot-gas-cleanup (HGCU) system at the Process Development Unit at Waltz Mill, PA. Two external-bed desulfurization tests were conducted on this system. An evaluation of filter performance during in-bed and external-bed desulfurization testing was completed, and filter modifications were identified as follows: increase blowback pulse flow to enable continuation of TP-037-2 and redesign the filter internals to incorporate eight additional filter elements for future testing. In-bed desulfurization test TP-036-5 demonstrated that limestone is equal to dolomite as a desulfurizing sorbent; 208 hours of operation were successfully completed to expand the PDU data base using limestone as a sorbent. Work continued to resolve problems associated with the available procedures to quantify the reactivity of spent sorbent from PDU in-bed desulfurization testing. A PDU conceptual design was completed for an external sulfation system that will process spent in-bed sorbent. Additional fines recycle studies were conducted on thermal loss and thermal efficiency optimization, and PDU modifications were defined for improved fines recycle performances. These studies considered results of the most recent analyses and observations during in-bed desulfurization test TP-036-5 and external-bed desulfurization test TP-037-1. 6 refs.

35563 **(DOE/MC/21063—2578) A 32-Month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized bed gasification system: Quarterly report, July 1-September 30, 1986.** Haldipur, G.B.; Katta, S.; Kettering, E.; Lewandowski, D.A.; Lucas, J.L.; Schmidt, D.K.; Smith, K.J.; Weldon, J. (USDOE Morgantown Energy Technology Center, WV; KRW Energy Systems, Inc., Madison, PA (USA)). Jan 1988. Contract AC21-84MC21063. 149p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88001083/JAW.

Work at KRW this reporting period focused primarily on design of an external hot gas zinc ferrite desulfurization process (Task 1) and PDU testing of an in-bed desulfurization and alkali removal system (Task 2) to develop PDU-scale data. Under Task 1, work continued toward finalizing subsystem design specifications and releasing procurement packages for system components so that PDU modifications can begin no later than December 1985. In-bed desulfurization testing at the PDU thus far has provided the following operational and process performance insights: in-bed desulfurization with dolomite is operationally feasible without great effect on gasifier performance and carbon utilization; dolomite feed and withdrawal rates can be independently controlled to assure dolomite balance; sulfur removal greater than 90% can be achieved with a high-sulfur (4.6%) coal versus 86% with a lower sulfur (2.4%) coal; maximum carbon conversion efficiency of 93% was achieved during TP-036-3 (S.P. 7B). Carbon conversion efficiency was affected by performance of the fines recycle system. Analyses of data collected to date show that the primary parameters influencing desulfurization efficiency are: high bed dolomite concentration, low moisture content of the product gas, the mass input of sulfur, and gas residence time. 67 figs., 23 tabs.

35564 **(DOE/MC/22059—2570-Vol.2) Revised users manual, Pulverized Coal Gasification or Combustion: 2-dimensional (87-PCGC-2): Final report, Volume 2.** Smith, P.J.; Smoot, L.D.; Brewster, B.S. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). Dec 1987. Contract AC21-85MC22059. 323p. NTIS, PC A14;3. Order Number DE88001071/JAW.

A two-dimensional, steady-state model for describing a variety of reactive and non-reactive flows, including pulverized coal combustion and gasification, is presented. Recent code revisions and additions are described. The model, referred to as 87-PCGC-2, is applicable to cylindrical axi-symmetric systems. Turbulence is accounted for in both the fluid mechanics equations and the combustion scheme. Radiation from gases, walls, and particles is taken into account using either a flux method or discrete ordinates method. The particle phase is modeled in a Lagrangian framework, such that mean paths of particle groups are followed. Several multi-step coal devolatilization schemes are included along with a heterogeneous reaction scheme that allows for both diffusion and chemical reaction. Major gas-phase reactions are modeled assuming local instantaneous equilibrium, and thus the reaction rates are limited by the turbulent rate mixing. A NO/sub x/ finite rate chemistry submodel is included which integrates chemical kinetics and the statistics of the turbulence. The gas phase is described by elliptic partial differential equations that are solved by an iterative line-by-line technique. Under-relaxation is used to achieve numerical stability. The generalized nature of the model allows for calculation of isothermal fluid mechanicsgaseous combustion, droplet combustion, particulate combustion and various mixtures of the above, including combustion of coal-water and coal-oil slurries. Both combustion and gasification environments are permissible. User information and theory are presented, along with sample problems. 106 refs.

35565 **(DOE/MC/23075—2405) Measurement and modeling of advanced coal conversion: Quarterly report for the period April 1-June 30, 1987.** Solomon, P.R.; Hamblen, D.G.; Serio, M.A.; Smoot, L.D.; Brewster, S. (Advanced Fuel Research, Inc., East Hartford, CT (USA); Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering). Jun 1987. Contract AC21-86MC23075. 141p. NTIS, PC A07;3. Order Number DE87006521/JAW.

During the third quarter work continued on characterization and pyrolysis of the Argonne coal samples. Additional work was done on mass transfer effects. To model pyrolysis data for low heating rate experiments, the internal mass transfer resistance to tar escape must be included. Preliminary design of the high-pressure reactor was completed. Studies of ignition were continued in the transparent wall reactor (TWR). The literature search was continued to identify the important effects of coal minerals in determining coal behavior. Experiments have also begun on the examination of the mineral composition and transformation of eight Argonne premium heat and mass transport effects in coal pyrolysis continued. In addition, calculations were done to define regimes of internal and external heat and mass transport control for conditions of interest. The mechanisms and rates of thermal NO formation in fuel-lean and fuel-rich conditions were determined from the literature. Two flow reactor configurations were designed and fabrication initiated for the NO/sub x/SO/sub x/ studies. The effect of neglecting turbulent fluctuation in gasification, was investigated. Code sensitivity to several thermal parameters affecting devolatilization was also investigated. A literature review was conducted of existing fixed-bed models for coal gasification. Available codes were identified for installation at BYU, and steps were taken to obtain those codes. A general outline of desired features to be included in the advanced model was developed. 60 refs.

35566 **(DOE/MC/23288—2580) Steam conditioning of coal for anyfuels productions: Third quarterly report, July 1-September 30, 1987.** Graff, R.A.; Zhou, P.; Brandes, S.D. (City Coll., New York (USA)). 1987. Contract AC21-87MC23288. 43p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010301/JAW.

Conditioning of coal in steam is being explored for the purpose of improving the yield and quality of condensable product obtainable in the mild gasification of coal. Yields of volatiles released during both steam and helium conditioning were determined for Illinois No. 6 coal and Mississippi lignite using weight loss measurements. Previously reported extraction yields for Illinois No. 6 coal were recalculated using the new data. A suprising new conditioning regime of considerable potential importance has been (tentatively) discovered for Illinois No. 6 coal at atmospheric pressure and temperatures between 518 and 644{degree}F (270 and 340{degree}C). Mild gasification of Illinois No. 6 coal was studied at 750 psia in the semicontinuous reactor system. The high liquid yields previously obtained after steam conditioning with this reactor operated in the injection mode are not now being realized with this reactor operating in the semicontinuous mode. The recovery and analytical methods were reexamined and the total recovery improved, from 90 wt % or less, to 92 to 96 wt %. A series of runs made using the same amount of coal as that fed in the injection mode did not give the improved yields. The possibility that helium flowing through the feed tube prevents access of steam to the reacting coal will be examined. Substantial progress has been made on the construction of the fluidized bed mild gasification test facility.

35567 **(DOE/METC—88/4076) A systems identification study: Methodology, algorithms, and application: Technical note.** Lawson, L.O.; Reel, J.A.; Keech, T.W. Jr. (USDOE Morgantown Energy Technology Center, WV). Nov 1987. 72p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88001033/JAW.

This report has presented work done in two major areas of system identification, time domain, and frequency domain analysis. In time domain analysis, the parametric method of representing a system, was chosen because it lends itself more effectively to practical applications. Modeling methodologies for single-input/single-output and for multivariable systems were developed. An algorithm was developed for general applications using the recursive least-squares estimation technique of parameter estimation. The algorithm is very flexible in that the vector and matrix sizes are automatically adjusted within the program to account for the system delay in data used in the estimation. In each test where the actual output was compared to the estimated out-put, the results appeared to be quite favorable. The tests with known process time delay also yielded good model performance. The time domain method of system modeling has good noise rejection capability. The time domain method can be performed from data evident of normal process perturbations, whereas the frequency domain method requires that specific driving inputs be applied to the process. The recursive nature of the developed algorithm has the potential for real-time implementaion. Adaptive control and process monitoring are candidate application. 17 refs., 25 figs.

35568 **(DOE/PC/79912—T1) Thiophene metabolism by E. coli: Technical progress report, September 15, 1987-March 15, 1988.** Clark, D.P. (Southern Illinois Univ., Carbondale (USA). Dept. of Microbiology). 1988. Contract FG22-87PC79912. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011159/JAW.

This report describes initial efforts at elucidating the mechanism of thiophene degradation by {und E. coli} by characterization of the genes involved. The objectives are to elucidate the biochemical pathway, to identify the genes involved and to determine how thiopene degradation is regulated. 3 tabs.

35569 **(DOE/PC/80516—11) Control of catalyst deactivation with ammonia: Quarterly report for period March 1, 1988 to May 31, 1988.** Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 1988. Contract FG22-85PC80516. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011567/JAW.

Some of our principal conclusions are: (1) If ammonia is added during reaction, it may cause some inhibition; but when the ammonia is removed, the catalyst activity is increased above the initial base-line. This enhancement can last for many hours or indeed days. (2) In studies in which ammonia treatment was made in absence of reaction, the treatment was effective to varying degrees with respect to all the reactions studied. When deactivation during reaction (e.g., a hydrogenation reaction) was caused by strongly adsorbed organonitrogen compounds, such as 1,2,3,4 tetrahydroquinoline, activity remained depressed for many hours after the nitrogen compound was removed (e.g., for the length of the experiment). However, addition of ammonia completely restores activity, attributed to displacement of the organonitrogen species. HDS of dibenzothiophene behaves differently than other reactions studied in its response to N-compounds. Ammonia added during reaction had no inhibiting effect, contrary to that observed with other reactions. (3) In changing the way in which ammonia treatment is carried out we have found some effects of changing such variables as pressure, temperature, duration of exposure to NH_3 (beyond a minimum), etc. The greatest effect occurred when an organosulfur compound was fed in the presence of a H_2NH_3 mixture and in the presence of a trickling liquid. In a representative experiment this approximately doubled the rate constant for the HDO of dibenzofuran over that observed before treatment. 5 refs.

35570 **(DOE/PC/90016—T2) Feasibility of producing jet fuel from GPGP [Great Plains Gasification Plant] by-products: [Quarterly report] for the period August 17, 1987-November 16, 1987.** Willson, W.G.; Knudson, C.L.; Rindt, J.R. (North Dakota Univ., Grand Forks (USA). School of Engineering and Mines). 1987. Contract AC22-87PC90016. 48p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010233/JAW.

The primary objective of this project is to assess the technical and economic feasibility of producing aviation turbine fuel from by-product streams of the Great Plains Gasification Plant located in Beulah, ND. A secondary goal of the project is to assess the conversion of the by-product streams into a new, higher-density aviation fuel. GPGP currently produces 150 MM SCFD of synthetic natural gas from 16,000 tpd of North Dakota lignite. In addition the plant generates three liquid hydrocarbon streams : 730 barrels per day (BPD) naphtha, 880 BPD phenols, and 3200 BPD tar/oil. Work at the University of North Dakota Energy and Mineral Research Center has focused on two tasks performed in support of these objectives. The first task consisted of a detailed analysis of the by-product streams under consideration. Of the three streams, the tar oil stream is the largest and shows the most promise for ugrading to aviation turbine fuel. Detailed characterization data on the tar/oil were presented in the previous quarterly. A true boiling point (TBP) distillation was performed on the GPGP phenol stream, yielding nine fractions which were characterized using NMR, GC, and GC/MS. The second task involves an engineering

evaluation of by-product upgrading. Two methods are under investigation for the production of aviation fuel: single-stage, in which heteroatom removal and hydrogenation are accomplished in a single step, and two-stage, in which the heteroatoms are removed in the first-stage, and hydrogenation occurs during the second stage. Hydrogenation was improved by increased pressure and temperature, although the measured effect on aromatic content awaits further analyses. Data indicates that, to achieve complete nitrogen and sulfur removal, the preferred operating conditions are temperatures of 610-645{degrees}F and pressures of at least 2000 psig. 3 refs., 26 figs., 9 tabs.

35571 **(DOE/PC/90528—T4) Thermodynamics of coal liquid/solid systems: Quarterly progress report for the period of December 16, 1987 to March 15, 1988.** Holder, G.D. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Jun 1988. Contract FG22-86PC90528. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011602/JAW.

The effluent streams of coal liquefaction processes often contain both liquids and solids (THF or pyridine insolubles). The solids appear to affect the physical properties of these liquids due to the adsorption of the heavy liquid components on the coal surface. The design of liquefaction reactors and separation units is dependent to a great extent on the thermodynamics of these multicomponents, multiphase mixtures. The effort to develop data bases for coal liquefaction products has three basic components: (1) pure components physical properties, such as boiling point, critical temperature and pressure, acentric factor, molecular weight and specific gravity and polarity, (2) binary vapor pressure data which enables phase behavior to be calculated for binary and, assuming the interaction of unlike molecules are independent of the pressure of a third species, multicomponent systems, (3) vapor pressures of solid-liquid systems as a function of the solids content. This allows the effect that solids have on the distribution of liquids between phases to be calculated. 21 refs., 4 tabs.

35572 **(DOE/PC/90529—6) Micropore diffusion in coal chars under reactive conditions: Quarterly technical progress report, 15 December 1987--15 March 1988.** Calo, J.M.; Perkins, M.T.; Lilly, W.D. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1988. Contract FG22-86PC90529. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011422/JAW.

The current project is concerned with the development and application of a new technique to measure micropore diffusion under actual gasification conditions. The method is an outgrowth of and related to the transient kinetics approach to the measurement of kinetic rate parameters for char-gas reactions that has been developed in our laboratory. It can be shown that the initial transient behavior of a species introduced as a step-function into a "gradientless" reactor in which char is present, is controlled by the transport resistance offered by the char micropores. Therefore, this data can be analyzed for micropore diffusion time constants. In addition, due to the time-resolved nature of the process in the reactor, the initial diffusion step is separated (in time) from any subsequent gas-solid reaction steps. Therefore, diffusion measurements can be performed under gasification conditions. Though it is still premature to draw very many firm conclusions from our data thus far, there are, nevertheless, some important aspects that should be noted. Of primary importance is the conclusion that the experimental apparatus is sufficiently sensitive to measure variations in reactor space times of the requisite magnitude. Data reported both here and in the previous report have established the ability to measure diffusion time constants of relevant orders of magnitude. In addition, the data indicate activation energies on the order of 1--2 kcal/mol, which are characteristic of micropore diffusion processes reported elsewhere, and, therefore, reinforce our confidence in the technique. 13 refs., 5 figs.

35573 **(EUR—11128-EN-FR) Synthesis gas production in the blast furnace: Feasibility study. Demonstration project. Final report.** (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation; Universite Libre de Bruxelles (Belgium). Centre de Recherches Industrielles). 1987. 160p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

This is the final report of a feasibility study carried out in the framework of the European Commission Energy Demonstration Programme. The aim of the study was twofold: to determine whether the conversion of blast-furnace into a gas generator is technically feasible, and to evaluate the approximate cost price of the synthesis gas produced. It has been shown that the existing technique of injecting coal at the level of the tuyeres is directly applicable to coal gasification in the blast-furnace. Several operating scenarios have been studied, particularly in the light of the need to maintain an efficient circulation of fluids in the blast-furnace. From the economic viewpoint, the principal advantage of the process is that the capital investment required to convert the blast-furnace into a coal gasifier is relatively small compared to the cost of a conventional gas generator. The former has been estimated at around 20 millions ECU for a production capacity of 80,000 Nm^3 per hour ($CO + H_2$). If the estimates are confirmed by large-scale testing, the cost price of the gas will be 60% of the cost price, per gigajoule, of gas from normal coal gasification, 67% of the price of gas from the reforming of natural gas and 64% of the price of gas from liquid hydrocarbons. A large part of the study deals with the analysis of the potential end uses of the huge quantities of syngas that would have to be used should this technology be applied.

35574 **(NP—8010872) Catalytic hydrogenation of high volatile bituminous coal and various coal extracts: Final report for 1986/1987 SOMED Project.** Kispert, L.D. (Alabama Univ., University (USA). School of Mines and Energy Development). Sep 1987. 21p. School of Mines and Energy Development, Box 6282, University (Tuscaloosa), AL 35486. Order Number TI88010872/JAW.

Model compounds, naphthalene, quinolines, and isoquinoline (possible extracts of coal) were selectively hydrogenated to 1,2,3,4-tetrahydro products by a Ziegler type catalyst [I] made of cobalt stearate and triethyl aluminum (1:2 molar ratio) in hexane solvent and temperatures as low as 22{degree}C and hydrogen pressure of 700-800 psi. It was established that a hydrogen pressure greater than 300 psi is crucial for hydrogenation to occur. For instance, at a pressure of 300 psi, only 5% reduction of naphthalene was observed with the rest of the starting material remaining intact. The important feature of this Ziegler catalyst is that it works best at low temperatures, moderate pressures and short reaction times, most unusual for a Ziegler catalyst. The catalyst, however, failed to bring about any reduction with such compounds as 8-nitro-2-methylquinoling, 4-chloro-2-methylquinoline, phenol, and dibenzothiophene. These failures are not surprising as nitro compounds are known to interact with and deactivate similar catalysts and homogeneous transition metal catalysts usually fail in the present of sulfur containing compounds. 23 refs., 2 tabs.

35575 **(PB—88-197363/XAB) Fundamental investigations of underground coal gasification. Final report, March 1982-December 1986.** Gunn, R.D. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). Aug 1987. 72p. NTIS, PC A04/MF A01.

See also PB—83-243964.

The report presents several mathematical models of underground coal-gasification processes. Through these models, a much better theoretical understanding of underground coal gasification becomes possible. Specific phenomena studied were the effects of high-amplitude pressure oscillation, reverse combustion, spontaneous ignition at high pressures, an analytical model of reverse-combustion channeling, an exploratory study of electrolinking, cavity-growth behavior, and a technical evaluation of the Forestburg underground coal-gasification field test at Forestburg, Alberta. This test is especially interesting because the site was escavated after completion of the experiment.

35576 **(SAND—88-0976C) Pore structure evolution during gas-solid reactions occurring at high temperatures.** Zygourakis, K.; Glass, M.W. (Sandia National Labs., Albuquerque, NM (USA); Rice Univ., Houston, TX (USA). Dept. of Chemical Engineering). 1987. Contract AC04-76DP00789. 46p. (CONF-871113—8). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011547/JAW.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Coal particles were devolatilized in a captive-sample reactor at heating rates ranging from 0.1 to 1000{degree}C/s. Macropore structure measurements obtained via video microscopy and digital image processing techniques quantified the strong effects of pyrolysis heating rates, particle size and coal rank on the pore structure of the produced chars. Digitized photomicrographs of actual particle cross-sections obtained directly from the image processor were then used to simulate the gasification of these chars under strong diffusional limitations using an erosion algorithm. The discrete computational approach accounted for the irregular macropore structure of chars, the opening of initially closed porosity due to burn-through and the fragmentation of the original particles. Thus, quantitative on the temporal evolution of pore surface area and particle fragmentation was obtained by applying image analysis techniques. Simulation results show that the macropore structure, and hence the pyrolysis conditions, strongly affect the rate vs. conversion patterns in the regime of strong intraparticle diffusional limitations. Reactions rates for single particles increase initially in a "step-wise" fashion and distinct jumps occur when the reaction front reaches large internal cavities previously inaccessible to the reactant gases. Pronounced maxima in the rate vs. conversion curves are thus observed. Image sequences show that particles fragment into several smaller pieces as the gasification proceeds. Recent literature data on the gasification of single coal particles in a fluidized bed support our model predictions, pointing out both the inadequacy of shrinking core models and the importance of particle fragmentation. 25 refs., 23 figs.

35577 **(VTT-TUTK—492) Techno-economic assessment of high-pressure peat liquefaction.** McKeough, P.; Tulenheimo, V. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1987. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752873/JAW.

The study is part of a research program, the aim of which is to identify the most promising process concept for the conversion of peat into transport fuels by high-pressure liquefaction. The study consists of techno-economic assessments of a base-case concept and of four sensitivity-case concepts. The products are heavy primary oils which require further upgrading into transport fuels. The designs of the processes were based on data generated in bench-scale experiments. The feedstock capacity of the base-case concept was 1990 t/d of milled peat (50wt% moisture) and the main results of the economic evaluation of this concept were (costs as of mid-1985): total capital requirement 86 x 10''6 USD (8% interest rate), production costs of primary product 6.4 USD/GJ (for peat price of 1.7 USD/GJ), overall thermal efficiency 62% (HHV basis). On the basis of the results of the sensitivity studies it was concluded that thermal drying of milled peat, prior to liquefaction, is advantageous; that the concentration of peat in the feed slurry should be limited to about 30 wt% solids; that operating pressures lower than 20 MPa should be sought; and that the economics of the process are not sensitive to the chosen method separating solids from the product stream. A preliminary estimate of the costs of upgrading the primary product into gasoline was also made. Gasoline production costs in the range 10-12 USD/GJ were obtained for the base case. This is a promising result, particularly when the Finnish refinery price (exclusive of taxes) is used as a reference.

35578 **(VTT-TUTK—507) Flash-pyrolysis of peat, wood, bark and lignin. Pyrolysis tests with Finnish peat at the University of Waterloo.** Piskorz, J.; Scott, D.S.; Vesterberg, I.B.; Arpiainen, V. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753003/JAW.

Flash pyrolysis is the rapid thermal decomposition of an organic material in an oxygen-free atmosphere. Research on flash pyrolysis is a rather new field, whilst research on conventional pyrolysis, employing slow heating, has long traditions. By using flash pyrolysis, it is possible to convert a large part of the feed material into organic liquids. This liquid material can be used directly as a fuel oil. After further treatment it could possibly be used as a source of motor fuels or chemicals. The publication deals with flash pyrolysis tests carried out with Finnish Peat in fluidized bed reactors. The experimental work was performed at the University of Waterloo, Canada. A bench-scale unit (10-100 g/h) was the main tool in this test programme. In one experiment a larger (pilot) unit (1-3 kg/h) was employed. Earlier pyrolysis tests with wood, bagasse, peat, straw and coal provided interesting reference data. The main objective of the work was to investigate the effects of temperature (range 450-750 deg C), reactive atmosphere (nitrogen, methane) and gas-phase residence time (0.30-1.00 s) on the organic liquid yields. The pilot run was done at near optimal conditions to produce a larger quantity of organic liquid. The highest yield of recovered organic liquids about 50 wt-% of moisture and ash-free raw material, was found at about 450-475 deg C using the shortest residence time, 0.30 s. At temperatures over 500 deg C, the organic liquid yield decreased quickly in favour of gaseous components such as carbon monoxide and hydrocarbons. The maximum yield of light olefins was found to be about 10 wt-% at the highest temperature employed (750 deg C). Methane was an inert reaction gas in the conditions of these tests. The total recovery of pyrolysis products was excellent, typically 98-100%. The pyrolysis tests were carried out under virtually steady-state reaction conditions. Agreement between the bench-scale results and the pilot test results was very good.

35579 **Process and apparatus for coal hydrogenation.** Ruether, J.A. (to Dept. of Energy, Washington, DC). US Patent 4,735,706. 5 Apr 1988. Filed date 27 May 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for the hydrogenation of coal in a reactor operating at a pressure substantially greater than atmospheric pressure at elevated temperatures in the presence of a catalyst for converting the coal to hydrocarbon liquids and gasses, is described comprising the steps of preparing an aqueous slurry of coal particulates, a water soluble catalyst and water with the water being in a sufficient amount to effect the dissolution of the catalyst and to provide the slurry with the sufficiently low viscosity to be mechanically pumped, adding an adequate amount of oil to the slurry to form agglomerates of the coal particulates, agitating the slurry to form the agglomerates, mechanically pumping the resulting slurry containing the agglomerates, excess water and unagglomerated solids to a pressure of at least about 1000 psig, separating the agglomerates from excess water and unagglomerated solids, passing the separated agglomerates through a dryer-preheater, contacting the agglomerates in the dryer-preheater with a stream of hot gas flowing countercurrently to the direction of flow of the agglomerates for drying the agglomerates, depositing the catalyst on the agglomerates and preheating the agglomerates prior to introduction thereof into a hydrogenation reactor. Thereafter contact the coat particulates in the reactor with liquid reaction products and hot hydrogen to effect the hydrogenation of coal particulates at a pressure of at least about 1000 psig and a temperature in a range of about 340° to 450°C.

35580 **Synthesis, structure, and reactivity of $[Fe(dbt)(CO)_2(Cp)][BF_4]$ and related S-bonded thiophene complexes.** Goodrich, J.D.; Nickias, P.N.; Selegue, J.P. (Univ. of Kentucky, Lexington (USA)). *Inorganic Chemistry;* 26: No. 21, 3424-3426(21 Oct 1987).

Organometallic compounds including iron and molybdenum carbonyls are known to catalyze the hydrodesulfurization and hydroliquefaction of coal. Thiophenes, especially dibenzothiophene, (dbt), are the best models for organically bound sulfur in coal, but there are few good models for the attachment of thiophenes to metallic catalysts via sulfur, a bonding mode currently believed to be the first step in structure of an iron-dibenzothiophene complex in which the thiophene is not part of a chelating ligand system are described herein. Both spectroscopic and single-crystal x-ray diffraction studies of the Fe-thiophene complex indicated that the thiophene ligands in different thiophenes are bonded to the iron via sulfur only. 29 references, 1 figure.

35581 **Application of model compounds to the study of microbial degradation of coal.** Campbell, J.A.; Frederickson, J.K.; Stewart, D.L.; Pyne, J.W.; Wilson, B.W.; Bean, R.M. (Pacific Northwest Labs., Richland, WA (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

Cohen and Gabriele first reported the ability of certain microbes to degrade low-rank coals. They showed that a white-rot fungus, P. versicolor, could metabolize oxidized lignite, producing a high molecular weight, highly polar and water soluble material. To better understand the mechanisms of key reactions involved in the degradation process, model compounds having coal-related functional groups were utilized. P. versicolor and P. chrysosporium were cultured in Kirk's minimal medium (10ml) for 10 days in 125 ml Erlenmeyer flasks. Benzyl benzoate and methoxybenzophenone, model compounds, were added to the cultures to obtain 10 and 100 μg/ml. After incubation for several days, the cultures were filtered and extracted with chloroform. The extracts were concentrated and analyzed by GC/FID and GC/MS to determine the amount of degradation and identify the degradation products. These model compounds will also be investigated utilizing cell-free enzymes.

0105 By-products

REFER ALSO TO CITATION(S) 35570, 35586

0106 Properties

REFER ALSO TO CITATION(S) 35553, 35570, 35625, 37021, 37051

35582 **(DOE/PC/70795—T9) The macromolecular chemistry of coalification: Quarterly report for the period November 1, 1987-January 31, 1988.** Kovac, J.; Moore, C.E. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 21 Mar 1988. Contract FG22-84PC70795. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007330/JAW.

A systematic non-linear least squares analysis of coal swelling data has been initiated. Four different theoretical models will be used. The theoretical parameters tested include the incorporation of non-Gaussian chain statistics and the incorporation of the logarithmic volume term in the swelling equation. The data analyzed are the data obtained by Larsen, Green and Kovac. The first analyses are reported here. 3 refs., 2 tabs.

35583 **(DOE/PC/80517—T10) Improving the stability of coal slurries: Quarterly progress report for the period December 15, 1987-March 15, 1988.** Fogler, H.S. (Michigan Univ., Ann Arbor (USA). Dept. of Chemical Engineering). 1988. Contract FG22-85PC80517. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008102/JAW.

Last reports showed that the conformational change (steric effect) of acidic polysaccharides on the surface with the solution pH is responsible for change of stability and peptization. This conformational change is influenced by the nature of electrostatic interactions between the surface and the polysaccharides. To explore this influence, both positively charged amidine latices and negatively charged sulfate latices were used with poly (galacturonic acid), PGUA, as a stabilizer. Results showed that the stability of amidine latices is greater at lower pH, which had also been found for sulfate latices. Photon correlation spectroscopy study showed that PGUA gives a comparable steric layer thickness with sulfate latices to that with amidine latices at the same pH due to the electrostatic repulsion between the negatively charged surface and the negatively charged PGUA. The conformational change causing peptization was found to be strongly influenced by the electrostatic interaction between particles and the adsorbed polymer. In case of amidine latices, lowering the pH did not immediately bring about the peptization because of the strong adsorption while the sulfate latices could be peptized. In order to study the peptization mechanism of sulfate latices, the decrease in turbidity during peptization of doublets was analyzed using the optical cross sections obtained from Mie theory. Results showed that the peptization rate is proportional to the particle concentration of doublets and that the peptization rate constant does not change with time. 9 refs., 6 figs., 1 tab.

35584 **(DOE/PC/80529—T8) Effects of coal structure on pulverized coal combustion processes: Quarterly technical progress report No. 10 for the period 1 January 1988-31 March 1988.** Wells, W.F.; Smoot, D.L. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 15 Apr 1988. Contract FG22-85PC80529. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009171/JAW.

The general objective of this study is to define and quantify the relationships between coal composition and structure and associated combustion and conversion behavior for three very different domestic coals of interest. To accomplish this objective, two tasks have been identified. The first is to characterize the virgin coal and the process chars. This will give the necessary information to determine if the char preparation process yields or rates are dependent on coal chemical or physical characteristics. In the past, insufficient information about the char physical and chemical structure has been a hindrance to the determination of their influence on reaction rate. The characterization tests outlined will give a detailed knowledge of the coals and chars. The second task is to measure the high temperature reaction rates of the virgin coals and their derived chars, and to interpret results in light of Task 1. 17 refs., 14 figs., 4 tabs.

35585 **(EPRI-CS—5644-Vol.1) Laboratory guidelines and procedures for coal analysis: Volume 1, Assessing the cleanability of fine coal.** Bosold, R.C.; Glessner, D.M. (Electric Power Research Inst., Palo Alto, CA (USA)). May 1988. 128p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011528/JAW.

The conventional laboratory static bath float/sink method of measuring the theoretical limits of coal cleaning is unreliable for ultra-fine (minus 100M topsize) coal particles because of their long and erratic settling rates. Developing a reliable method to assess the theoretical cleanability of ultra-fine coal has been given impetus by the increased emphasis on reducing sulfur dioxide emissions from power plants, greater quantities of fines created by mechanized mining methods, and the development of advanced physical coal cleaning processes that grind coal to ultra-fine sizes in an effort to achieve high coal impurities liberation. EPRI, therefore, commissioned researchers at the Homer City Coal Laboratory in western Pennsylvania to develop and demonstrate a float/sink procedure for ultra-fine sizes. Based on test work performed on two ultra-fine size fractions (100M x 200M and 200M x 0), a detailed laboratory procedure using a centrifugal device was established. Results obtained using the guideline presented in this report are as accurate as those obtained using the static bath float/sink method, and for 200M x 0 material, more accurate. In addition, the centrifugal procedure is faster and less costly than the conventional static bath float/sink method. 12 refs., 32 figs., 1 tab.

35586 **(NZERDC-P—108) Image analysis of New Zealand coke.** Clemens, A.H. (New Zealand Energy Research and Development Committee, Auckland). Aug 1986. 27p. Coal Research Association of New Zealand, Wellington.

Buller coal-derived coke samples were being considered as a source of anode carbon. A semi-automated VIDS II Image Analysis System attached to a microscope using reflected light was used to study the coke porosity. It was found that a coke with a high open porosity contribution from large open pores, and of sufficient strength, would be the most likely to generate an anode of acceptable baked density. However other factors, possibly related to the extent of ordered coke structure, are also important. 10 refs.

35587 **(PB—88-197405/XAB) Electron-transfer reactions in coal-model compounds. Annual report, January-December 1987.** Penn, J.H. (West Virginia Univ., Morgantown (USA). Dept. of Chemistry). Mar 1988. 52p. NTIS, PC A04/MF A01.

Oxidation of benzpinacol (BPC) was effected with two Fe(III) (1,10-phenanthroline)3 complexes. The product of these reactions is exclusively benzophenone when 2,6-di-t-butylpyridine is

added to the solution. The rates of the electron-transfer process were determined by monitoring the change of the Fe(III) and Fe(II) concentrations by uv-vis spectroscopy. By measuring the rates of the electron transfer as a function of temperature, activation parameters for the electron-transfer process from BPC to Fe(III) (1,10-phenanthroline)3 and to Fe(III) (4,7-diphenyl-1,10-phenanthroline)3 were determined. These data indicate the importance of entropy in potential electron-transfer reactions. Novel bond-cleavage reactions have been observed through the use of added oxygen indicating a new mechanistic pathway for coal-polymer fragmentation.

35588 **(SAND—87-1165C) The design of methane activation catalysts.** Stohl, F.V.; Shelnutt, J.A.; Granoff, B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880602—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88002265/JAW.

From 9. international catalysis congress; Calgary, Canada (26 Jun 1988).

The goal of Sandia's methane activation program is to use computer-aided-design (CAD) techniques to guide the synthesis of catalysts for the direct conversion of methane. Several enzymes, such as cytochrome P_{450} and methane monooxygenase, catalyze the oxidation of alkanes to alcohols at low temperatures and pressures. we are attempting to design catalysts that mimic these enzymes. Our CAD studies on porphyrins, which are the active sites in many enzymes, are being combined with 1) structural characterization of naturally occuring catalysts; 2) the development of activity and selectivity tests; and 3) the synthesis and characterization of designed catalysts. Results of CAD studies on enzymes that carry out alkane activation or perform C_1 chemistry and on unique synthetic porphyrins have shown that the synthetic porphyrins can have site configurations analogous to these enzymes. The CAD work also uses molecular-energy minimization and dynamics calculations to evaluate methane interactions with the synthetic porphyrins. Activity tests have been set up for cyclohexane, hexane and butane with additional tests being developed for methane and ethane. Synthesis of designed porphyrins is currently underway. 9 refs., 4 figs.

35589 **(STEV-TORV—87-11) Contents of duff in sod peat. Final report.** Stridsberg, S. (Statens Energiverk, Stockholm (Sweden)). Jun 1987. 64p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752963/JAW.

The relatively high dryness of the sod peat makes it a very competitive fuel. However, the final quality is very much dependent of the virgin peat and specific production conditions. Difficulties will occur particularly in connection with the sometimes high content of fines. These will, besides fire hazard in storage, also cause freezing and bridging problems and complications in combustion by blocking the grates. During the project work analyses have been carried out at 5 different boiler plants, both samples collected at random from peat deliveries and samples from selected points in the plant to find out how much the transport equipment will chrush the sod peat. The analyses normally show reasonable contents of duff, 5-10% < 5mm particle size. This is the particle size limit where we know from experience that the operational troubles occur. Of course this limit also is related to the equipment and as an example a thin grate will be sensible for particles already at 15 mm size. If the content of fines is too high it will be more and more common to screen the sod peat at the bog. The investigation has also handled the dependance of moisture and ash content of the fractional distribution. The moisture content is higher in peat duff than in the whole pieces. This corresponds to the peat from the bog and the moisture content of the duff might be 10% higher than that of the pieces. We have to distinguish between delivered peat duff and small particle fraction generated in the plant. The worst treatment of the peat will appear in screw conveyors, screw feeding equipment and several bar feeders, as the influence is negligible in scraper, band and elevator conveyors. Thus the choice of transport equipment could strongly effect on the economy.

35590 **(STEV-TORV—87-15) Determination of bulk density in sod peat and milled peat.** Sandstroem, T.; Burvall, J.; Wigge, B. (Statens Energiverk, Stockholm (Sweden)). Feb 1987. 28p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752964/JAW.

Stiftelsen Svensk Torvforskning Project Report 13.

Different kinds of vessels have been tested to compare repeatability of measuring within one vessel type and reproducibility between different vessel types. The types of vessel have been compared with measurement of bulk density in large container (truck container). For bulk density in larger container, difference in results depends on following criteria: - Measurement in connection with loaded or unloaded container. - The number of sampling points on the surface in the container. - If the surface in the cargo has been even out or not before measuring. The investigation shows that, comparable results between measuring in a vessel and measuring in a large container is obtained in the material if the vessel is packed until constant weight approves. The reproducibility in results, comparing bulk density in a large container against measuring bulk density in a vessel (packed until constant weight approves) is good provided that: - The material in the container must be even out before measuring. - At least 5 points must be measured in the container. - Measuring must bee done at the occasion of unloading the container. - The density must be reported as basic density. (authors).

35591 **(STEV-TORV—87-18) Sampling for the analysis of fractional distribution of peat and biomass fuels.** Sandstroem, T. (Statens Energiverk, Stockholm (Sweden)). Sep 1987. 60p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752967/JAW.

The variation for each method has been evaluated as well as differences between them. Size distribution has also been measured within a load for three types of wood fuel and sod peat. Finally a number of sod peat and wood fuel assortments have been characterized with respect to particle size and each fraction analyzed for ash content and dry matter. The following results have been obtained: -Particle size distribution shows a considerable variation both within and between different fuel types. The fraction smaller than 3mm varied between 7.0-21.7% with respect to dry matter while sod peat varied from 1.8 to 8.0%. -For chips of branches and whole-tree chips dry matter decreased with decreasing particle size. -Ash content in fraction <3mm was considerably higher for branch chips and whole-tree chips compared with other fractions.For sod peat with mineral contamination ash content increased with decreasing particle size. -The variation in particle size distribution within a load was large. The difference between the biggest and smallest value was in some cases larger than the mean of the fraction. -All fuel types are equally inhomogenious. -No significant differences was found between the different sampling methods. -Sod peat sampling during tipping showed a clear dependence on the position of the sampler in the stream. Close to the vehicle the amount of smaller particles was higher than farther away from the vehicle. Sampling for particle size analysis should preferrably be done on falling material. In practise this means when unloading the truck or between two conveyors.

35592 **(SVF—254) Testing of coal and sorbents from low NOsub(x) and SOsub(x) reduction at Stigsnaes Power Plant and trial results from Stigsnaes Power Plant.** Bengtsson, M. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Mar 1987. 43p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88752981/JAW.

Coal and sorbents from full scale trials for NOsub(x) reduction and SOsub(x) capture from Stigsnaes power plant have been tested. The coal has been tested by DTGA, and in a drop tube furnace. Devolatilization burn-out and N release have been studied. The devolatilization was considerably slower and less than for Polish coal when comparing DTGA, DTF and pyrolysis data. The Gondwana coal had a high inertinite content. The two sorbents, Danish limestone and calcium hydrate, reached a high degree of calcination already after 75 ms at 1050 degrees C. The maximum BET-area was also reached at that point indicating that a high sorption of SO/sb2/ ought to be possible at that temperature. The NOsub(x) emission for this coal was high, ca 1000 ppm,0% O/sb2/, dry. Special arrangement for NOsub(x) reduction resulted in up to 25% NOsub(x) reduction. Unusually high temperature zones, ca

1700 degrees C, were found 1.5 m from the burners. The devolatilization and N-evolution from coal and char was slow in the lab tests. SOsub(x) capture by Danish limestone Ca/S ca 2 at 100% load reduced SOsub(x) emission by 20-23%. At 70% load the reduction was ca 10% higher. To achieve a better SOsub(x) capture new injection ports will be located further upstream in the boiler where the temperature is lower. The NOsub(x)-emission was higher than normal. The performed tests by changing the air distribution in the existing burners at reduced load resulted in a 25% lowering of the emission, which was less than expected.

35593 **(SVF—273) Determination of the calorific value of solid fuels.** Oesterholm, L.H.; Andersson, L. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Aug 1987. 114p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753345/JAW.

The investigations made in this project show that there is no bias between standard methods and instrumental methods. Standard methods are, however, more accurate than instrumental methods. There may be larger differences in accuracy between different laboratories. This is due not only to the type of calorimeter, or the condition of used instrument, but also to insufficient knowledge in calorimetry. The determination of moisture in the analysis sample has been shown to be a surprisingly large source of error. The moisture determination may be highly biased depending on method used. The investigations also show that the correction for nitric acid is practically independent of the nitrogen content of the sample. Also, it is not necessary to add water to the bomb before combustion. The calorific value decreased with ageing of the fuel. This makes it difficult to develop certified reference materials for QA. Experiences gained from the project may be used in future standardization work. In Sweden a common standard could be developed for determination of gross calorific values of coal, peat, wood and bark. This project was run at the National Testing Institute (Sweden) where five standard methods and two instrumental methods for determination of calorific value of coal, peat, wood and bark have been investigated. A round robin test with 24 participating laboratories in Denmark, Finland and Sweden has been run to provide more statistical material. (authors).

35594 **(VTT-TIED—762) Properties of biomass and peat fuels. Handbook.** Alakangas, E.; Kanervirta, M-L.; Kallio, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Sep 1987. 130p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752994/JAW.

The aim of this publication is to consider the properties of solid indigenous fuels like peat, wood and straw. We also want to introduce the properties of domestic fuels from various points, on the basis of several different sources and thus offer the readers the opportunity to compare. The hand-book is mainly collected of reports published at the Technical Research Centre of Finland (VTT). Additionally, the results from analyses carried out by VTT's Laboratory of Fuel Processing and Lubrication Technology and Domestic Fuel Laboratory have been utilized. At the beginning of the book there are definitions of the properties. The information from different sources has been standardized to correspond to the definitions. At the end of each chapter there is a referencelist. The chapters of the hand-book have been divided into two groups: firstly, general properties, modern production methods and methods of use of each fuel are described. Secondly, the production, handling and application technical properties are presented in tables and figures. Also the emissions of the fuels have been treated. At the end of the publication there are comparison tables of the most important.

35595 **Ruthenium tetraoxide catalyzed oxidation of maceral groups.** Choi, C.; Wang, S.H.; Stock, L.M. (Argonne National Lab., IL (USA)). *Energy and Fuels;* **2**: No. 1, 37-48(Jan-Feb 1988).

Pure liptinite, vitrinite, and inertinite group maceral fractions from a representative high-volatile A bituminous coal have been oxidized with ruthenium (VIII) to produce a broad series of aliphatic carboxylic and benzenecarboxylic acids. Chromatographic and mass spectroscopic procedures were used to identify these compounds, and isotope dilution techniques were used to establish the yields of certain key products. The product distributions from the individual macerals differ considerably. Generally speaking, the observations for the benzenecarboxylic acids indicate the dominance of 1,2-fused benzene rings and suggest that the aromatic structures in the three different maceral groups are similar. The broad array of aliphatic acids obtained from the three macerals imply that the aliphatic structural components of the vitrinite and inertinite maceral groups are similar with hydroaromatic compounds predominating whereas the liptinite group contains polymethylene chains that bridge aromatic structures. Thus, the differences between the inertinite and vitrinite arise from variations in the concentrations of similar types of aromatic and hydroaromatic structures whereas the liptinites contain other quite different aliphatic substances.

35596 **Association of major, minor and trace inorganic elements with lignites. III. Trace elements in four lignites and general discussion of all data from this study.** Given, P.H.; Miller, R.N. (Pennsylvania State Univ., University Park (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 7, 1843-1853(Jul 1987).

Fourteen trace elements (La, Cr, Sc, Y, Yb, Ga, Ni, V, Be, Zr, Ge, Pb, Sn, Ce) have been determined by emission spectroscopy in the ash from 7-17 levels within four early Tertiary lignite seams from Wyoming, Texas and Alabama, and two elements (Cu, Zn) in the acid-soluble and acid-insoluble fractions of the samples by inductively coupled plasma arc emission spectrometry. These elements were also determined in the roof and floor strata enclosing the seams. In a general discussion of the results of the whole series of three papers, a model describing the incorporation of inorganic components in peats is presented, based on the erosion of rocks by chelating organic acids and other agents, followed by transport in water and trapping of mineral grains and dissolved ions by the organic matter of peat. Inorganic materials in peat thus constitute the principal input of mineral matter into coals. The elements that tend to be enriched near the margins of lignite seams are mostly those that have complexed with organic matter. However, the data on this enrichment from the authors own and previously published work are quite variable, no doubt depending on the nature and efficiency of transport of the incoming cations.

35597 **A numerical study of coal particle heating and its influence on devolatilization.** Celik, I.; Godbole, D.B.; O'Brien, T.J. (Dept. of Mechanical and Aerospace Engineering, West Virginia Univ., Morgantown, WV (US)). pp 223-229 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

This paper reports a numerical study of the steady, turbulent, reacting two-phase (gas-coal) flow in an entrained-flow reactor using a state-of-the-art computer code. Emphasis is focused on the temperature history and heating rates of individual coal particles. The iterative solution procedure resolves the gas flow in an Eulerian and the particulate flow in a Lagrangian frame of reference, respectively. The turbulent gas motion is modeled using the standard κ-ϵ model. The devolatilization is modeled using two competing reactions. The interactions between the two phases are accounted for by including the particle mass, momentum, and energy sources in the gas flow equations for each computational cell. The mechanism by which the particle temperature history affects the devolatilization process is elucidated. The predicted volatile yields are in good agreement with measurements.

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REFER ALSO TO CITATION(S) 35626, 35754, 36157, 36158, 37661, 37702, 37706, 37709

35598 **(CEGB-OED-STB(S)—87-0014-R) P.F. ash injection as a means of preventing potential acid smut emission during high oil burn.** Foreman, R.C.; Moss, W.K.A.; Pankhurst, K.S. (Central Electricity Generating Board, Gravesend (UK). Operational Engineering Div.). May 1987. 18p. Central Electricity Generating Board, Gravesend (United Kingdom). Operational Engineering Division, Scientific and Technical Branch.

While Tilbury 'B' Power Station was operating with an oil burn of 90% by heat release, tests were carried out to determine whether recycled pulverised fuel ash (PFA) mixed with the coal burned could be used as an alkaline additive to prevent the emission of acid smuts from the chimneys. PFA was added to the coal so as to adjust the total ash content to that expected for a coal burn of 20% by heat release. This report describes measurements made on Unit 7. The main findings are as follows: at an oil burn of 90% by heat release, SO_3 levels were higher than expected for coal firing alone; accumulation rates of solids on temperature-controlled samplers were higher than expected for oil firing alone; there was no likelihood of acid smut emission at the 90% oil burn while the extra PFA was being added. The report recommends that for sustained operation at an oil burn in excess of 80% by heat release, additional PFA should be added to the coal feed to give a total ash loading equivalent to a 20% coal burn. Steps should be taken to ensure that this ash is only recycled once, and consideration should be given to the environmental implications of its disposal. 13 refs., 2 figs., 7 tabs.

35599 **(CONF-8803102—2) The salt models of two advanced electron beam FGC processes.** Hu, N.; Chang, S.L.; Berry, G.F. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01;3. Order Number DE88009963/JAW.

From International conference on advanced science and technology; Chicago, IL, USA (19 Mar 1988).

Conventional wet limestone flue gas desulfurization systems are primarily used for moderate (e.g., 50%) reductions in sulfur emissions at some coal-fired power plants. Advanced flue gas clean-up methods using the combination of electron beam and alkali injection techniques have been introduced to remove pollutants SO/sub x/ and NO/sub x/ from the glue gas more effectively (e.g., 90%) than conventional methods. To enhance their potential applications and provide a common base for the comparisons of their performances and costs, computer simulation models are needed. In this paper, two simulation models, the electron beam spray dryer and the electron beam ammonia injection processes, which are major electron beam variants under development in the US, are introduced. These simulation models use the System Analysis Language Translator code developed at Argonne National Laboratory to study the performance and cost of the gas clean-up methods and can be readily integrated into a comprehensive modeling of the entire power plant. Some preliminary result of these flue gas clean-up models will be presented.

35600 **(CRIE-U—87016) Assessment of fertilization effect of fly ash on high-analysis synthetic compound fertilizers. Fertilizer response test using Komatsuna, Brassica campestris L.** Aoki, Masanori; Umezawa, Takeshi; Okabe, Katsumi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 28p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752541/JAW.

New fertilizers were developed to expand the application of fly ash and complement some shortcomings in physical properties of ammonium nitrate and urea fertilizers. These fertilizers are synthetic compound fertilizers containing three elements produced in such a way that raw nitrogeneous and potash fertilizers are mixed with the phosphoric acid suspension of fly ash and the mixture is granulated or moulded utilizing the spontaneous setup caused by the gelation of silicic acid. The cultivation test of 'Komatsuna', Brassica campestris L., using the fertilizers was made in accordance with the 'Methods of Cultivation Test on Harm to Plants' in the Fertilizer Control Law. The fertilization effect of applying a large quantity of the test specimen of high-analysis synthetic compound fertilizers utilizing fly ash was higher than that of the control fertilizer. No harm to the growth by excessive application was observed. This is because the diffusion of salts from the test specimen is lower than that from the control fertilizer. These fertilizers meet, therefore, the requirements of the Fertilizer Control Law. (4 figs, 7 tabs, 2 refs)

35601 **(CRIE-U—87020) Screening of ground cover crops for fly ash disposal area.** Kono, Yoshihisa; Ogawa, Tadashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Sep 1987. 18p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752544/JAW.

Examination was made on the screening of ground cover forage crops for fly ash disposal area. For selecting herbs tolerant to alkaline fly ash, commercially-available forage crops of Leguminosae and Gramineae were cultivated. In Leguminosae, clovers, particularly, white clover exhibited high adaptability to the fly ash rather than to the sand soil, and could grow in the symbiosis with the root nodules. The forage crops of Gramineae were inferior in the growth except for a part of the crops. Even in the case of no volcanic ash face soil layer on the fly ash, the white clover could be cultivated. However, the growth was ununiform, since the seeds flew away or were buried into the ground. The use of a 2 - 5 cm surface soil layer improved significantly the crop growth. In the use of the volcanic ash having no underlayer of fly ash, the growth performance of the crops was inferior after the garmination. For the sowing, the appropriate seed amount was about twice the standard. White clover is applicable for early-covering the fly ash disposal area by using a 2 - 5 cm surface soil layer. (2 figs, 7 tabs, 9 refs)

35602 **(CRIE-W—86025) Characteristics of pressure loss during filtration using a porous ceramic filter.** Ito, Shigeo; Watanabe, Masatoshi; Makino, Hisao; Nagayama, Tsutomu; Tanaka, Takashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1987. 31p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752547/JAW.

Characteristics of pressure loss during filtration was studied using a porous ceramic filter (PF). Immediately after the filtration started, collected particles formed a thin layer on the PF surface, which was transferred to cake filtration. Pressure loss during filtration was expressed as the sum of the loss in the filter and that in the particle layer. The effect of plugged surface pores with fine particles was evaluated as the change of permeability. Increase rate of pressure loss during filtration was proportional to the particle concentration, 2.6 power of the filtration rate and square of the specific surface area. When the filtration rate became larger, however, the porosity decreased and pressure loss increased because the pressure gradient increased in the collected particle layer and the particle layer was compacted. It is necessary to elucidate the compacted properties of collected particle layer to estimate more accurately the pressure loss. (20 figs, 5 tabs, 8 refs)

35603 **(DOE/PC/81006—T2) Aqueous reaction of fly ash and $Ca(OH)_2$ to produce calcium silicate absorbent for flue gas desulfurization.** Peterson, J.; Rochelle, G.T. (Texas Univ., Austin (USA). Dept. of Chemical Engineering). [1988]. Contract FG22-85PC81006. 77p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010129/JAW.

To examine the effect of slurrying conditions upon solids reactivity, slurries of fly ash and $Ca(OH)_2$ were monitored for dissolved metal concentrations with atomic absorption spectrophotometry. The solids produced were dried and tested for reactivity towards SO_2 in a packed bed reactor at bag filter conditions. The solids formed in slurries containing 10 to 100 ppM of dissolved calcium were up to 40% more reactive than the solids formed in slurries containing less than 10 ppM or more than 100 ppM of dissolved calcium. The dissolved calcium concentration was affected by NaOH concentration, fly ash loading (g fly ashg $Ca(OH)_2$), slurry temperature, fly ash type, and the presence of $CaSO_3$ {center←dot} 0.5 H_2O. High calcium fly ash could be activated to remove 1.3 mmol SO_2g sorbent which is almost as reactive as the

solids prepared by slurrying low calcium fly ash with $Ca(OH)_2$ at a fly ash loading of 4 (1.44 mmol SO_2g). Low and medium calcium fly ashes, under identical slurrying conditions removed only 0.33 mmol SO_2g sorbent.

35604 **(DOE/PC/90524—T2) Chemical degradation of substituted aromatic hydrocarbon compounds in soil/sediment systems: Progress report.** Shanmuganantha, S.; Luthy, R.G. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering). Jan 1988. Contract FG22-86PC90524. 114p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88007108/JAW.

This study investigated the role of manganese oxide as an oxidant for substituted aromatic organic solutes. Manganese oxide may be the most reactive oxidizing agent in soils and sediments in the absence of molecular oxygen and nitrate. The study provides data on chemical mechanisms for abiotic degradation of anthropogenic organic solutes in soilsediment and groundwater systems. The dissolution of MnOOH and δMnO_2 was studied with five nitrogen-containing aromatic compounds and seven alkyl-substituted aromatics under anoxic conditions. Screening tests were performed at several values of pH and initial organic and oxide concentrations, and the rates of dissolution were evaluated. Quinoline, methylimidazole and 5.5-dimethyl hydantoin did not exhibit a significant dissolution rate at pH values around 6.0. Aniline dissolved δMnO_2 readily at a pH value of 4.4 but not at pH = 6.5 in tests with comparatively high initial concentrations (5 {times} 10^{-3}M) of organic and oxide. A methoxy substituent of aniline, p-anisidine, dissolved δMnO_2 very rapidly at low pH (4.4) with comparatively low concentrations of organic (6.25 {times} 10^{-5}M) and oxide (3.25 {times} 10^{-4}M). Hydroquinone, catechol and their alkyl substituents dissolved appreciable amounts of δMnO_2 at pH 6.5, with initial organic concentrations in the range of 5 {times} 10^{-4}M to 5 {times} 10^{-3}M and initial oxide concentrations around 2 {times} 10^{-3}M. An equation is presented which describes dissolution rate (up to about 15% manganese dissolution) for low initial organic concentrations (5 {times} 10^{-4}M and 1.5 {times} 10^{-3}M) with the assumption that the organic soluted are two equivalent reductants. In general, alkyl substitution increased the reaction rate except for trimethyl hydroquinone. Reactivity also increased with the size of the alkyl substituent. 29 refs., 46 figs., 17 tabs.

35605 **(EPRI-CS—5783) Laboratory characterization of advanced SO_2 control by-products: Furnace sorbent injection wastes: Final report.** Eklund, A.G.; Achord, R.D.; Owens, J.B. (ICF Technology, Inc., Richland, WA (USA)). May 1988. 169p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011423/JAW.

This report on the solid waste characterization of furnace sorbent injection wastes is the second in a series of five advanced SO_2 control waste characterization reports reaulting from Task 2 of Research Project 2708-1. Task 2, Solid Waste Characterization, involved a detailed characterization of solid waste products based on literature and property determinations. The chemical, physical, engineering, and leaching properties of furnace sorbent injection wastes will be used to support the evaluation of waste management design and operation and potential utilization in Tasks 3 and 4 of this project. Results indicate that furnace sorbent injection wastes, although varied in chemical composition, can be handled in waste management systems designed for western (alkaline) fly ash. Waste handling systems may require designs for larger volumes and masses of dry wastes. Chemical differences between furnace sorbent injection wastes and fly ash are greater than physical and engineering property differences. Chemical properties may require that waste management systems in which furnace sorbent injection wastes will be exposed to moisture be protected or properly engineered for temperature resistance, corrosion resistance, alkaline liquids, and the possibility of rapid self-hardening. If solids are handled dry, waste management systems may require some modifications to handle finer particles and prevent fugitive dust emissions. 5 refs., 32 figs., 18 tabs.

35606 **(IEACR—05) Particulate control for coal combustion.** Klingspor, J.S.; Vernon, J.L. (IEA Coal Research, London (UK)). Feb 1988. 71p. NTIS (US Sales Only), PC A04/MF A01;1. Order Number TI88900490/JAW.

Although control of particulate emissions from coal combustion systems is a mature technology, a wide range of work is under way to improve the applicability, performance and cost-effectiveness of particulate control equipment. Particulate control technologies in commercial operation for control of emissions form coal combustion sources are mainly mechanical collectors, electrostatic precipitators, fabrics and wet scrubbers. These technologies are described in detail in terms of basic principles, collection mechanisms, performance and costs. The economics of particulate control technologies are considerably influenced by site-specific factors. In general terms, however, they are unlikely to exceed 5 to 10% of total plant captial and annual costs. Whilst cyclones are the cheapest form of particulate control, they are generally unable to meet the strict emission standards now being introduced for large combustion systems. The relative costs of ESPs and fabric filters vary, depending on precise emission standards, coal type, combustion system type and size. High operating costs for wet scrubbers have limited their application in recent years. 156 refs., 24 figs., 17 tabs.

35607 **(PB—88-188073/XAB) Evaluation of the use of power plant pond ash in highway construction.** Sheffield, J.P. (Mississippi State Highway Dept., Jackson (USA). Research and Development Div.). Jan 1988. 77p. (STATE STUDY—85). NTIS, PC A05/MF A01.

The objective of this study is to evaluate power plant pond ash as a base course material. Pond ash consists of fly ash and bottom ash that have been codisposed of by sluicing to a disposal pond. The different base courses containing pond ash are: (1) 6-in. course of fine pond ash and 7% (by weight of pond ash) lime; (2) 6-in. course consisting of 5 parts coarse pond ash and 1 part sand clay plus 7% (by weight of pond ash) lime; (3) 6-in. course consisting of 5 parts coarse pond ash and 1 part sand clay plus 7.5% (by weight of pond ash) portland cement; (4) 8-in. course consisting of 50% each of pond ash and sand clay plus 2% (by weight of pond ash) lime; and (5) 8-in. course consisting of 50% each of pond ash and sand clay plus 6% (by weight of pond-ash) lime. To date, all pond ash courses appear superior to the control section which is an 8 in. course consisting of sand clay mechanically stabilized with washed gravel. The pond ash sections and the control section will continue to be evaluated on an annual basis for three years.

35608 **(RISO-M—2667) Sulphur dioxide reduction in fluidized bed combustion. Part 2. Test of 4 selected types of limestone in Risoes 300 kW fluidized bed.** Kaiser, N.E. (Risoe National Lab., Roskilde (Denmark)). Sep 1987. 20p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752929/JAW.

Reduction of sulphur dioxide in flue gas in fluidized beds by adding limestone has been investigated. 14 different types of limestone have been tested in a laboratory facility. 4 types have been selected for a test in Risoes 300 kW fluidized bed, and 3 types have been tested in dk-TEKNIKs 1MW fluidized bed. Finally one type has been tested in a 12 MW fluidized bed in a district heating station located in Skanderborg. This report describes the tests in Risoes 300 kW fluidized bed.

35609 **(RISO-M—2668) Sulphur dioxide reduction in fluidized bed combustion. Part 4. Full scale test in Skanderborg district heating station.** Kaiser, N.E. (Risoe National Lab., Roskilde (Denmark)). May 1987. 30p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752930/JAW.

Reduction of sulphur dioxide in flue gas in fluidized beds by adding limestone has been investigated. 14 different types of limestone have been tested in a laboratory facility. 4 types have been selected for a test in Risoes 300 kW fluidized bed, and 3 types have been tested in dk-TEKNIKs 1MW fluidized bed. Finally one type has been tested in a 12 MW fluidized bed in a district heating station located in Skanderborg. This report describes the final test in Skanderborg district heating station.

35610 **(RISO-M—2669) Sulphur dioxide reduction in fluidized bed combustion. Final report. Summary of the whole project.** Kaiser, N.E. (Risoe National Lab., Roskilde (Denmark)). Sep 1987. 22p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752931/JAW.

Reduction of sulphur dioxide in flue gas in fluidized beds by adding limestone has been investigated. 14 different types of limestone have been tested in a laboratory facility. 4 types have been selected for a test in Risoe's 300 kW fluidized bed, and 3 types have been tested in dk-TEKNIKs 1MW fluidized bed. Finally one type has been tested in a 12 MW fluidized bed in a district heating station located in Skanderborg. This report is a summary of the whole project.

35611 **(STEV-FBT—87-33) Modelling of the sulphation of calcined limestone and dolomite - A gas-solid reaction with structural changes in the presence of inert solids.** Alvfors, P.; Svedberg, G. (Statens Energiverk, Stockholm (Sweden)). Dec 1986. 53p. (In Swedish and English). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752949/JAW.

The partially sintered spheres model (PSSM) is further developed to account for the influence of inert material present in the solid reactant. This model is applicable e.g. to the sulphation of CaO with a variable amount of inert material. An example is the reaction between calcined dolomite, CaO.MgO and SO_3, when used as SO_2-sorbent in the boiler furnace. The results show that the active part of the sorbent reaches a higher degree of conversion when inert material is present. (authors).

35612 **(STEV-FBT—88-2) Denitrification of flue gases. Final report.** Ekman, T. (Statens Energiverk, Stockholm (Sweden)). Nov 1987. 86p. (In Swedish, German and English). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752954/JAW.

The pilot-plant for denitrification of flue gas which is situated at the Oeresund plant in Malmoe operates on selective catalytic reduction (SCR). The flue gas is taken after particulate and SO/sb2/ removal. It passes a Ljungstroem type regenerative heat exchanger where the gas is heated from 70 degrees C to 300 degrees C. In an electric heater the gas is further heated to 350 degrees C and then divided between two ducts. Four different catalysts, based on V/sb2/O/sb5/ - TiO/sb2/ have been tested, 1500 hours each. The catalysts show a linear relation to the degree of reaction and ammonia addition up to at least 90% reduction. Leakage of ammonia is less than 5ppm. The temperature dependence of catalysts is low and there was no change of catalytic activities after 1500 hours.

35613 **(VTT-TIED—775) Finnish limestone types in desulphurization.** Panula-Nikkilae, E.; Nieminen, M.; Hepola, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1987. 83p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752996/JAW.

The report includes a survey of limestone characteristics and of the quality of Finnish limestone products, a literature review of additives improving the desulphurization capacity of limestone and a study of pore structure and calcium content analytics. The Finnish carbonate stones are crystalline metamorphosed calcites and dolomites. Their most significant impurities are silica, magnesium and aluminium. In southern and southwestern Finland, calcitic limestone types are mostly found, in northern and eastern Finland dolomite and dolomitic limestone. The characteristics of the most significant limestone products from the three biggest carbonate producers in Finland are presented. The desulphurization capacity of limestone can be improved by using inorganic additives, some per cents of the limestone amount. 1 to 5-fold reaction rates have usually been achieved compared to the use of unpromoted limestone. The most significant additives: chrome, sodium, magnesium, potassium, lithium, iron, and chlorine and the results obtained from their use are presented. Chrome oxide proved to be chemically the most effective, but its use is restricted due to environmental impacts. Alkali metal salts are fairly effective and have only minor drawbacks. Iron and added magnesium are rather ineffective in furnace conditions. Pore structure and chemical analytics of desulphurization materials are closely related to the desulphurization experiments. Different methods suitable for use with experimental desulphurization methods are presented. These methods have in part been obtained from the literature and in part developed in this research work.

35614 **(VTT-TUTK—508) Desulphurization by limestone injection. A study of the reactivity of Finnish limestone grades on an isothermic flow reactor.** Hepola, J.; Nieminen, M.; Panula-Nikkilae, E.; Aeijaelae, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Nov 1987. 139p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753004/JAW.

Injection is expected to be a competitive desulphurization method for flue gases. The desulphurization capacity of Finnish limestone grades in furnace conditions was studied on an isothermic flow reactor constructed in the laboratory. The effect of temperature, residence time, flue gas composition and limestone grade, particle size and amount on the calcination and sulphating rate and desulphurization was studied. The effect of small amounts of different metal compounds and ashes on the desulphurization capacity of limestones was also investigated. In calcination tests without sulphur carried out in a flue gas atmosphere equal to that in coal combustion, fine limestone powder was calcinated nearly totally, regardless of limestone type, in some tenths of a second at about 1000 deg C. The calcination was accelerated whilst the particle size of limestone was reduced. Calcium hydroxide was calcinated faster than limestone. The particle size of the limestones was reduced during calcination. The BET areas varied according to limestone coarseness and grade. Simultaneous calcination and sulphating was also studied. There were no greater differences compared to the tests without sulphur. The fine limestone grades bound sulphur more than the coarser ones. The major part of the coarse limestone grades was sulphated in 0.3 s, whilst the desulphurization capacity of finer limestone grades increased more clearly when the reaction time grew to 1 s. The degree of Ca utilization was 10-15% for coarse limestones, 20-25% for fine limestones and about 10% for calcium hydroxide. The SO_2 content and the amount of limestone fed to the reactor had no essential effect on the degree of Ca utilization. There were no greater differences in the desulphurization capacity of different limestone grades.

35615 **Process for the combined removal of SO_2 and NO/sub x/ from flue gas.** Chang, S.G.; Littlejohn, D.; Liu, D.K.; Griffiths, E.A. (to Dept. of Energy, Washington, DC). US Patent 4,732,744. 22 Mar 1988. Filed date 27 Oct 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A process of the simultaneous removal of NO/sub x/ and SO_2 from a fluid stream itself comprised of NO/sub x/ and SO/sub x/, is described which comprises: (A) contacting the fluid stream in a contacting zone with an aqueous reaction mixture itself comprising an effective amount of an iron (II) chelate of an amino acid moiety having at least one -SH group selected from amino acids, N-substituted amino acids, natural peptides and synthetic peptides, and an alkali which comprises a basic salt selected from the salts of sodium, potassium, lithium, calcium or magnesium, (B) separating the fluid stream from the particulates formed in step (A) which particulates comprise the chelate of the amino acid moiety and fly ash; (C) washing with the particulates of step (B) with a relatively neutral aqueous solution having a pH of between about 5 and 8 with subsequent separation of the aqueous wash and the particulates; (D) subsequently washing the particulates of step (C) with an acidic aqueous solution of a mineral acid; (E) washing of the particulates of step (D) with an alkaline aqueous solution having a pH of between about 9 and 12 with subsequent separation of the aqueous wash and the particulates; (F) adding additional amino acid moiety, iron (II) ion, and an alkali which comprise a basic salt selected from the salts of sodium potassium, lithium, calcium or magnesium to produce an effective concentration of chelating aqueous solution or slurry having a pH of between about 4 to 12; and (G) recycling the aqueous solution of step (F) to the contact zone of step (A).

35616 **An analytical study of coal-fired boiler performance using CO_2O_2 or $CO_2O_2H_2O$ mixtures instead of air as oxidizers.** Richter, W.; Li, W.; Payne, R. (Energy and Environmental Research Corp., Irvine, CA (US)). pp 1989-1996 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879067.

The paper deals with a process in which mixtures of recycled combustion products CO_2 or CO_2H_2O and O_2 from air separation are used as oxidizers instead of air to support combustion in boiler furnaces. The process can be applied to generate CO_2 for enhanced oil recovery. The feasibility of the process is investigated for an existing 50 MWe lignite fired boiler using a Monte-Carlo type heat transfer zone model. Optimum oxidizers molar ratios were determined which yielded most similar thermal performance of the boiler compared to air operation. The ability of the model to predict accurately relative performance changes between air and recycling operation was verified by model application to small-scale experiments. Results of the study show that optimum molar ratios for the boiler investigated are $CO_2O_2 = 2.7$ for the dry and $(CO_2 + H_2O)O_2 = 3.2$ for the wet recycle process. Within a range +- 0.4 of the optimum ratios performance changes are minimal compared to air operation.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 37174, 37711, 37757

35617 **(DOE/PC/90753—T8) Coal ash deposition, interaction with metal substrates and deposit build up.** Birks, N. (Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering). 1988. Contract FG22-86PC90753. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011920/JAW.

It is believed that the corrosive action of coal ash is primarily due to the formation of liquid phases. As such, initial experiments have been applied to demonstrate that, in the presence of a liquid phase, the attack is more pronounced, and also that in the absence of a liquid phase, very little attack beyond normal oxidation occurs. The results from the study showed that during reaction of the ash/slag with the atmosphere, compositional changes can occur within the coating that may affect the chances of liquid formation. It was also found that it was not sufficient for the coatings to have a low melting point, they must also form a liquid of relatively low viscosity to show very rapid attack. Future activities will pursue this line of research extending the studies to higher temperatures as well as beginning to incorporate representatives of coal minerals into the ash powder to be applied to the specimens. Eventually, a mechanistic model of the processes will be derived.

35618 **(NEI-SE—10) Environmental effects of methane production from peat in situ.** Wallentinus, H.G. (Lund Univ. (Sweden). Dept. of Geology). 26 Jan 1987. 19p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88752921/JAW.

The vegetation at the Kallbrunnsmossen - a bog exploited for in-situ methane production - has been analyzed since 1983. Water samples are also taken at several points across the bog. Visible damage is produced by mechanical wear from transports etc. Certain chemical/ physical parameters have varied considerably over the years, i.e. pH, water color and conductivity. Significant changes in vegetation are also noted.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 35649

35619 **(NAGRA-NTB—87-15, pp 535-542) Coalification and geothermics in Meso- and Paleozoic sediments of Northern Switzerland and comparison to coalification data from Southern Germany.** Wolf, M.; Hagemann, H.W. (Technische Hochschule Aachen (Germany, F.R.)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Coalification studies were carried out on samples of the boreholes Schafisheim, Riniken and Weiach (Northern Switzerland). They show a relative high rank of the coals of Stephanian age explored by the Weiach borehole. The phenomenon is explained by unnormal high heating of the seams during the late Palaeozoic. The sediments of Mesozoic age have more or less the same rank in northern Switzerland, although they are situated today at different depth. The coalification process of these sediments must have been finished before the last tectonic events occurred. A similar development of temperatures and rank is derivable for the Palaeozoic and Mesozoic of the Schramberg trough, explored by the borehole Urach 3. The structure of this trough, situated in south Germany, is similar to the Permocarboniferous trough of northern Switzerland. (author) 12 refs., 1 fig., 4 tabs.

0120 Mining

REFER ALSO TO CITATION(S) 35712

35620 **(STEV-TORV—87-16) Follow-up of operation and production studies of sod peat machines during 1986 - HUDDIG HPM 100 and SUOKONE PK 1 - WANKEL.** Westermark, N.E.; Ericsson, E.; Anttila, R.; Dryler, K. (Statens Energiverk, Stockholm (Sweden)). Feb 1987. 47p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752965/JAW.

In production on fields free of stumps, HPM 100 has lower capacity than PK1-S with the new disc in relation to supplied power (in kw). The extruder on HPM 100 is the limiting factor. This is driven by the motor mounted on the machine. If too high power is supplied to the excavator disc by the tractor it fails to press out the whole amount of peat. In production on fields rich in stumps HPM 100 has a higher production than PK1-S with the new disc. This depends on the better cutting qualities of the disc and on the fact that the excavator disc can be reversed by hydraulic drifting. The drying periods for the excavated peat seems to be of about the same order for all the tested machines with perhaps a small tendency for shorter drying periods in the second harvest for HPM 100. The produced amount of peat per spreading area without overlapping, is less with HPM 100 than PK1-S. The excavating capacity with the new disc on PK1-S seems to increase with increased driving speed and increased supplied power while the highest capacity with HPM 100 is reached with lower speed (less than 2000 m/h). The fuel consumption with HPM 100 has varied between 24.5 l/h and 29.9 l/h (including driving tractor). For PK1-S with the new disc the corresponding value was 13.2 l/h. With fuel consumption expressed per ton of raw peat the consumption for HPM 100 was 0.30 l/ton raw peat (1.77 l/ton dry matter) and for PK1-S with the new disc 0.25 l/ton raw peat 1.26 l/ton dry matter). PK1-S with the new disc consequently had the lowest fuel consumption per produced unit as well as the largest volume of produced raw peat in this study. (authors).

35621 **(STEV-TORV—87-17) Technique of reducing losses of material and substances on piling and storing of peat.** Anttila, R. (Statens Energiverk, Stockholm (Sweden)). Sep 1987. 56p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752966/JAW.

Swedish Peat Research Foundation has investigated piling and storing of peat during two years. The project has been carried out by Scantorv AB (former Svensk Torvfoeraedling) and the secretariat office of Swedish Peat Research Foundation in which Kent

Dryler has been responsible for parts concerning material losses in stockpile bottom and surface. The objective of the project is to elucidate kinds of technical problems occurring when piling and storing peat and to find methods for decreasing substance- and energy losses, fire hazard, and costs for piling and covering piles. The presented results have been obtained by literature studies, collection of experiences and field experiments. Evaluation of the result shows that heat-generation and fire hazard do not mean any greater problem for the peat producers. Losses in many forms are occurring more or less and should be reduced to the greatest possible extent for achieving good production economy. Areas desired for development of new technology is technology and machinery for piling and material and technology for covering piles. Recommendation for piling have been drawn up and are described in the report.

35622 **(STEV-TORV—88-5) Follow-up of operations and machine studies of a stacking device.** Olsson, R. (Statens Energiverk, Stockholm (Sweden)). Mar 1987. 42p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88752970/JAW.

A mixed system with combined milled and sod peat production has been carried out on Anttjaernmyran. This bog is situated in the community of Oeverkalix in the north part of Sweden. A stacking machine equipped for both screening and stacking was used for sorting out and piling milled and sod peat in different stockpiles. When using a stacking machine following has been registered among other things: - decreased moisture content with 8% in sorted sod peat. That means increased energy value with 18%. - increased amount of coarse fraction (>45mm) with 31%-units in sorted sod peat. - decreased amount of fine fraction (<3mm) with 17%-units in sorted sod peat. The stacking machine has good degree of screening and availability and satisfying capacity after modification of parts in the machine. Based on this study and SST-project with the title 'Combination system milled and sod peat', it is indicated that the draft gives a positive margin calculated on a normal production year. The combined production system will continue with almost the same draft going on during the production season 1987.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 35632, 35635, 35640, 37312

35623 **(DOE/PC/90958—T4) Study of dense phase cohesive coal transport in plugs: Quarterly report, January-March 1988.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1988. Contract FG22-86PC90958. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010308/JAW.

The experiment for single plug flow conveying was performed Pittsburgh and Virginia coals. Early attempts to use a mixture of 90%-200 Mesh coal powder are not successful. After sifting the coarse particle out, the plug stability was increased significantly. The method of supplying the conveying air is also important. Early attempts to supply the conveying air supply slowly were not successful. The plug collapsed after less than 10 feet. Thus, the method of supplying the air supply slowly is suitable for the short distance conveying less than 10 feet only. Then the conveying air was supplied by a quick opening through a solenoid valve. For this arrangement the coal can be transported for a distance 40 feet. To date we have completed the experiments for the pipe length of 20 feet. Figure 3 and 4 show the preasure drop vs. initial plug length at different air velocities for Pittsburgh and Virginia coals. We have not used the model yet to predict the pressure losses because as it was observed that the rear of the plug kept breaking off from the main plug and depositing in the bottom of the pipe. Thus, the initial plug length is not the actual plug length. We will use the light probe system to measure the actual plug length and the model will be applied properly. 5 figs.

0140 Combustion

REFER ALSO TO CITATION(S) 35563, 35564, 35583, 35584, 35608, 35609, 35610, 35611, 35644, 35940, 36156, 36677, 37253, 37255

35624 **(AERE-R—12976) Evaluation of laser measurement techniques for pulverised coal combustion.** Abbott, M.P.; Ereaut, P.R.; Williams, D.R.; Porter, F.M.; Sykes, J.; Baker, C.A. (UKAEA Harwell Lab. Engineering Science Div.). Feb 1988. 19p. (HCCP/R—10-1987; CONF-880802—). H.M. Stationery Office, London, price Pound 4.00.

From 22. international symposium on combustion; Seattle, WA, USA (14 Aug 1988).

Laser-Doppler anemometry (LDA), laser sheet illumination and coherent anti-Stokes Raman spectroscopy (CARS), used previously for natural gas and kerosene flames, have now been applied to a laboratory gas-supported coal flame. The main objectives were to assess the optical techniques and to identify any experimental problems before using the instruments on larger coal flames. Measurements using the three techniques were made in characteristic regions of the flame, corresponding to the gas flame, and the unburnt and devolatilised coal jets. The main conclusion is that LDA and CARS can be applied successfully and the measurements of mean axial velocity and turbulence intensity (LDA) and temperature (CARS) are consistent. The CARS software did however have to be modified to reject spectra dominated by signals produced by interactions between coal particles and the laser beams at the measurement volume. The laser sheet illumination enabled relative particle concentration in the inner coal jet to be mapped, but it was not possible to obtain particle velocities using the available laser system.

35625 **(DOE/METC—88/6084-Vol.1) Proceedings of the AR&TD [Advanced Research and Technology Development] direct utilization, and instrumentation and diagnostics contractors review meeting: Volume 1.** Holcombe, N.T. (ed.). (USDOE Morgantown Energy Technology Center, WV; USDOE Pittsburgh Energy Technology Center, PA). Oct 1987. 388p. (CONF-871041—Vol.1). NTIS, PC A17/MF A01;1; GPO Dep. Order Number DE88001002/JAW.

From Advanced research and technology development direct utilization; Morgantown, WV, USA (13 Oct 1987).

The Advanced Research and Technology Development (AR&TD) Direct Utilization, and Instrumentation and Diagnostics Contractors Review Meeting was held on October 14-16, 1987, at the Sheraton Lakeview Conference Center in Morgantown, West Virginia. This meeting was sponsored by the US Department of Energy (DOE), Office of Fossil Energy, and the Morgantown and Pittsburgh Energy Technology Centers, and this year was hosted by the Morgantown Energy Technology Center. This annual meeting provides a forum for the exchange of information between DOE AR&TD contractors and interested parties and was attended by approximately 200 individuals from industry, academia, national laboratories, and other Governmental agencies. Papers were presented on ongoing research and research results relating to combustion phenomena, coal properties, cleanup, mineral-matter transformations, pyrolysis, atomization, instrumentation, erosion/corrosion, and deposition. A total of 12 technical sessions were chaired by staff from both the Morgantown and Pittsburgh Energy Technology Centers. Conference coordination was provided by the Conference Services staff of EG&G Washington Analytical Services, Inc., Morgantown Operations. The proceedings have been reproduced from camera-ready manuscripts furnished by the authors. They have not been refereed, nor have they been extensively edited. Papers have been entered individually into EDB and ERA.

35626 **(EPRI-CS—5837) Fabric filter testing at the TVA Atmospheric Fluidized-bed Combustion (AFBC) Pilot Plant.** Cushing, K.M.; Bush, P.V.; Snyder, T.R. (Electric Power Research Inst., Palo Alto, CA (USA); Southern Research Inst., Birmingham, AL (USA)). May 1988. 202p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011431/JAW.

Experience with fluidized bed combustion (FBC) units on a research and industrial scale has indicated that FBC power plants

could be a viable alternative to pulverized-coal power plants with wet limestone scrubbers or spray dryers. To provide design confidence and the flexibility to evaluate process improvements, the Tennessee Valley Authority constructed a 20-MW(e) AFBC (bubbling bed) Pilot Plant. Subseqently, EPRI and Southern Research Institute entered into a program to monitor the performance of the fabric filter at the pilot plant. The objective of the program was to determine if unique characteristics of AFBC operation or emissions would require special design criteria or operating procedures in the application of fabric filtration to utility-size AFBC boilers. With reverse-gas cleaning the fabric filter experienced high tubesheet pressure drop while operating at low filtering air-to-cloth values and with low residual dustcake areal densities compared to fabric filters downstream from pulverized-coal boilers. This implied that the AFBC fly ash had properties distinct from those of pulverized-coal fly ash. Implementaion of reverse-gas cleaning with sonic assistance resulted in lower operating pressure drops at higher filtering air-to-cloth values, although slightly higher than comparable data from baghouses filtering pulverized-coal fly ash. Fly ash analyses showed that the AFBC ash particles are generally smaller, more irregualr in shape, and the dustcakes are lighter and more porous than those formed from pulverized-coal fly ashes. 8 refs., 18 figs., 7 tabs.

35627 **(KTM/E-D—138) Measuring methods for emissions from small and middle size boilers.** Laukkarinen, A.; Tirkkonen, T.; Jormanainen, P.; Puustinen, H.; Mehtonen, A.; Wellman, K. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Aug 1987. 75p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752826/JAW.

This study describes measuring methods for emissions from small and middle size boilers. Emissions from these boilers differ from emissions from large boilers, especially concentration of organic compounds and unburn gases are much higher. There was a need to develop new methods and to apply other methods which are mostly used for another purpose. Burning of peat, wood and expecially wood-based waste, f.ex. chipboard forms great number of compounds which are measured by different absorption and adsorption methods. In this study adsorption materials were tested and the tests shows, that it is possible to utilize one adsorption sample for several analyses. For tar measurements were developed a new rapid and simple method, which can be used for preliminary tests before comprehensive measurements. There are several methods for analyses of unburn gases. Because of numerous methods, results are not comparable. In this study was compared several methods for unburn gases with gas mixtures and with exhaust gases. It is obvious, that whoever measures unburn gases should know, what the instrument really measure and how the results will be used. Sulfur compounds in stack gases can cause significant errors in particulate measurements. Any condensation of water vapor on filter can affect a 100% error in particulate measurements. Duration of sampling dont have any measureable impact on the doncentration level.

35628 **(NEI-DK—59) Status and outlook for the technology of fluidized bed combustion. Preliminary project for the Danish Ministry of Energy.** Laut, P. (Danmarks Ingenioerakademi, Lyngby). Apr 1987. 100p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752834/JAW.

The Danish research activities in the field of fluidized bed combustion are evaluated in the light of the international development, taking into account the specific Danish conditions and requirements. The report is meant as a contribution to a debate going on once a year as to whom is to receive grants from the Danish Ministry of Energy for research projects on fluidized bed combustion. (HES).

35629 **(PB—88-184221/XAB) Modeling of char burnoff.** Hustad, J.E.; Vareide, D.; Soenju, O.K. (SINTEF, Trondheim (Norway)). Oct 1987. 44p. (STF—15-A87055). NTIS, PC E04/MF E04.

Two idealized models for the prediction of char burnoff are described: a progressive conversion model and a shrinking-particle models. Results from the model predictions are presented. Experiments were performed in a-250 kW fluidized-bed reactor, using propane as loading fuel. Studies of char burnoff are made in the freeboard region at various height locations. The char particles are fed into the reactor just above the bed section. The 4-m-high freeboard section allows particle residence time at up to 4 s. The char particle size varies from 90 to 268 micrometers and the temperature in the freeboard section range from 820 to 940 C. The oxygen concentration varies from 8% to 13.5%. The report was presented at a Combustion Seminar in Hensinki on the 12th of November 1987, organized by the Royal Nordic Council of Ministers.

35630 **(STEV-FBT—87-31) Reaction kinetics of the combustion of pulverized coal. Particle temperature.** Hellstroem, A. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). Jun 1985. 56p. (In Swedish). (STUDSVIK-EB—85-50). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752948/JAW.

The theory of particle combustion is described and a mathematical model for the calculation of the temperature is presented. The calculations are compared with existing empirical data. The measurement of the temperature of small particles is described.(G.B.).

35631 **(UCRL—21039) Tubing wastage in fluidized-bed coal combustors: Test Series 2 NCB (IEA Grimethorpe) Ltd.** Witherell, C.E.; Meisenheimer, R.G. (Lawrence Livermore National Lab., CA (USA)). 8 Jan 1988. Contract W-7405-ENG-48. 69p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009810/JAW.

This study of wasted heat-exchanger tubing from the Grimethorpe PFBC Facility was conducted to characterize affected fireside surfaces and identify the mechanism/s responsible. Examinations showed that the wasted surfaces are not typical of those produced by erosion alone, as oxide deposits are present on all surfaces. Continual exfoliation of the normally-protective oxide layer is probably responsible for a major portion of tubing wastage. There are also indications of direct metal loss occurring through a series of events wherein repeated formation and exfoliation of surface oxides produce an irregular metal interface that is mechanically deformed during combustor operation. Cold-worked metal protrusions, or platelets, on the roughened surface readily fracture from the tubing wall and are lost into the bed. In some combustors where metal temperatures generally are above 600 C (1100 F), sulfidation-oxidation corrosion has been identified as the mechanism responsible for metal loss. These occurrences have largely been confined to air heater tubes, uncooled support members, and the like. However, the more perplexing type of metal wastage in FBCs{endash}and that which is the subject of this study{endash}has occurred at much lower metal temperatures of about 400 C (750 F) in in-bed water-cooled tubes. There have been differences of opinion over its cause but the consensus is that erosion is a major factor, if not the sole cause. Examinations have shown that wasted surfaces of heat exchanger tubing from this combustor are the product of combined mechanical, chemical, and thermal effects, all interrelated to produce rapid and localized metal loss. 33 refs., 29 figs., 3 tabs.

35632 **(VTT-TUTK—499) Energy production from peat.** Pesonen, P.; Hallikas, J.; Asplund, D. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Sep 1987. 94p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753001/JAW.

A method has been developed in order to make it possible to evaluate energy production chains for allocation of research. The method has been applied to comparison of district heating chains (effect 3-10 MW) which use peat as fuel. The energy production chains to be compared are on different technical levels: some of them are commercially available and the rest may be in commercial use within 5-20 years. The chains have been planned to be operating entities themselves, which has required the choice of equipment and the compatibility of the whole process. As a result we have received technical characteristics and the price of heat. On the basis of these we have drawn conclusions about the problems of the energy chains and about the possibilities of further research. In ad-

dition, the usability of the method has been evaluated and it has been found very good.

35633 **Multiple monitoring of an entrained flow reactor.** Woodruff, S.D.; Combs, R.J. (Dept. of Energy, Morgantown, WV (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

A multi monitor has been developed to simultaneously measure gas temperature, particle temperature, and atomic concentrations through one set of optical access ports on a high temperature, high pressure entrained flow reactor. The three measurements continuously monitor the gas and particle flow in a reactor designed to characterize the combustion and deposition of powdered coal. The gas temperature is measured by scanning the OH radical emission at 307 nm, the particle temperature is measured by high speed, multi color pyrometry, and the atomic concentrations are measured by atomic adsorption. The multi monitor uses fiber optics to allow the three measurements to share a single lens and relay the optical data from the lens to the instrument.

35634 **Toward a mechanistic theory of net deposit growth from ash-laden flowing combustion gases: Self-regulated sticking of impacting particles and deposit erosion in the presence of vapor deposited - Or submicron mist - 'Glue'.** Rosner, D.E.; Nagarajan, R. (High Temperature Chemical Reaction Engineering Lab., Dept. of Chemical Engineering, Yale Univ., New Haven, CT (US)). pp 289-296 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

What determines the fraction of impacting 'ash' particles actually captured by a growing deposit? Based on the available literature, the answer to this important question is still largely unavailable. Simultaneous deposition of lower melting point compounds, present as vapors (or submicron mists), evidently provides a 'glue,' influencing many thermophysical properties of such deposits, including the incident particle sticking fraction, s, itself, as well as the particle erosion coefficient, e, (the average number of deposit particles removed per impacting particle). The authors outline here a new mechanistic approach to the mathematical modeling of deposit evolution. It is based on the notion that because of this glue/particle 'coupling,' the net inertial particle deposition rate cannot be calculated 'directly' but will seek a (quasi-)steady-state value such that the available glue will, as it were, 'allow' the impacting particles to be captured (and, simultaneously, dictate the deposit erosion rate). They illustrate how this concept of self-regulation would establish the (quasi-)steady-state values of s and e, and the (corresponding) net deposit growth rate under conditions representative of a pulverized coal combustion heat exchanger tube.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 35573, 35632

35635 **(CONF-8710324—) Appalachian coal: Meeting international energy needs.** (Virginia Coal Council, Richlands (USA)). 1987. Contract FG01-87FE61384. 308p. NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88010815/JAW.

From Appalachian coal: meeting international energy needs conference and exposition; Roanoke, VA, USA (27 Oct 1987).

The conference "Appalachian Coal: Meeting International Energy Needs"was held at the Hotel Roanoke, Roanoke, VA, October 27-29, 1987. The proceedings deal with the present problems of the appalachian coal industry: overcapacity rail transport charges low oil prices and competition from Australia, South Africa, Colombia, etc. Similarly, the railways are not making enough money to pay for installations, and new equipment they have to make, due largely to competition from trucks. The material was not susceptible to analytics and a person interested in one part would probably be interested in the whole proceedings. (LTN)

35636 **(DOE/EIA—0513) Changing structure of the US coal industry 1976-1986.** (USDOE Energy Information Administration, Washington, DC). 1988. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011881/JAW.

This report analyzes changes in the structure of the U.S. coal industry from 1976 through 1986, the most recent year for which comprehensive data are available. The merger activity is continuing, however, and two major mergers occurred in 1987. The effects of these and other recent mergers and divestitures on the structure of the coal industry were estimated. Taken together, they do not have a significant impact on coal production concentration and coal ownership patterns.

0160 Health And Safety

35637 **(IOM-TM—87-09) Dust-related risks of radiological changes in coalminers over a 40-year working life: report on work commissioned by NIOSH.** Hurley, J.F.; MacLaren, W.M. (Institute of Occupational Medicine, Edinburgh (UK)). Dec 1987. 70p. Institute of Occupational Medicine, Edinburgh, Scotland.

This study provides estimates of the prevalence of simple pneumoconiosis (CWSP) and of progressive massive fibrosis (PMF) in coal miners at eight successive five year periods of a forty year working life. The effect of varying the dust concentration exposure and carbon content of coal for various combinations of age is estimated. The findings of this report state that the limitation of dust exposures for all miners is the only reliable way of limiting PMF.

35638 **(IOM-TM—87-20) Mortality study of workers at a patent fuel plant.** Smith, T.A.; Hurley, J.F.; Henriksen, V.J.B.; Kidd, M.W.; Ruckley, V.A. (Institute of Occupational Medicine, Edinburgh (UK)). Dec 1987. 76p. Institute of Occupational Medicine, Edinburgh, Scotland.

The main purpose of the study was to determine the association, if any, between occupation at the patent fuel plant in South Wales and subsequent cause-specific mortality. Men in Wales of similar age distribution were used as a control group. 37 refs., 6 figs., 17 tabs.

35639 **(KTM/E-D—135) Safe production and use of domestic fuels. Final report.** Mutanen, K.; Linna, V.; Nissinen, K.; Rautalin, A.; Reunanen, M.; Rouhiainen, V.; Weckman, H. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 108p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752823/JAW.

The aim of the project is to improve the safe use of domestic fuels. In a follow-up study it was found out that in 26 power plants there had occured on the average 0.9 fires per operting year having caused material damages and interruptions in operation during years 1984-1986. According to prestudies the corresponding figure in 1979-1983 was 2 per year. Security risks and the possibilities to remove them were reserched through different security analysis methods. The explosion chracteristics were researched by carrying out explosion tests with peats of different humidity and particle sizes in a test drum of 20 litres. The biggest explosion pressure measured was about 10 bar and the K/sub st/-value was 183 bar .ms. In these tests it was also found out that the explosivity of peat cannot be forecast only by the overage humidity and particle size. There are adequately quick and sensitive sparkle alarm devices for observation of peat fires on mechanical conveyors. Gas alarm devices were found out to be suitable for controlling fires in fuel storages. Gas alarm devices should, however, be further researched because of faulty alarms.

35640 **(NEI-DK—79) Fire prevention in coal grinding plants, including their storage and transport systems of coal fines.** (Dansk Brandvaerns-Komite, Birkeroed). Sep 1987. 83p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752919/JAW.

The report contains a short description of the different types of coal grinding plants, the causes of fires and explosions in these, together with principles for plant protection. These are expanded to give more concrete recommendations for protection of coal grinding plants. An initial section on fire extinguishing equipment is followed by recommendations for protection of the different parts of the plant, such as raw coal bins, raw coal feed systems, grinder/pulverisers, cyclones, pulverised coal bins and pulverised coal pipe systems. A special section is devoted to recommendations for protection of transport tanks and containers for pulverised coal. In the final part of the report, an evaluation of the risk of coal dust explosions during coal grinding is carried out, based on a statistical treatment of accident reports. This evaluation is based on information obtained from a questionnaire sent to Danish power stations and industry, together with information obtained from abroad. 47 refs.

35641 **(VTT-TIED—787) Safe production and use of domestic fuels. The development of safe peathandling systems.** Nissinen, K.; Vuori, M.; Mutanen, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Nov 1987. 77p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752997/JAW.

The aim of the study is to evaluate the safety of different fuel handling equipments and the whole handling systems and to search for new and better solutions. The research was limited to the handling process in a peat power plant. The most harmful fact was that peat dust collects into fuel handling rooms. This increased the danger of fires and explosions. Leakages were found in peat handling chains due to fast wearing. Also the large quality variations of peat caused security problems. No dust problems occurred when a gavered drag chain conveyor was used. The fuel feeding equipment for the boiler was the most sensitive object and caused 21% of all fires. The fire safety of power plants can be improved by preventing the dust from spreading into the environment and by cleaning the rooms often. The fire alarm boxes and sprinklers can also be improved. Hidden dangerous factors can be determined by risk analyses and eliminated in advance. On the basis of the information received from the statistics and the research of real damages, safer power plants can be constructed.

0170 Legislation And Regulations

35642 **(GAO/RCED—87-193) Mineral resources: Interior's actions on three coal leases.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 16p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

A Bureau of Land Management proposal to suspend portions of three coal leases in western Colorado owned by West Elk Coal Company was designed to improve the likelihood that Atlantic Richfield would comply with a provision prohibiting a company and its affiliates from obtaining additional onshore federal mineral leases covered by the act.

02 PETROLEUM

REFER ALSO TO CITATION(S) 35547, 35694

35643 **(SI-R—860147-1) AI in offshore. A survey.** Arff, S.; Larsen, K.A. (Senter for Industriforskning, Oslo (Norway)). Mar 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752847/JAW.

The report presents an overview of Artificial Intelligence (AI) applications in the offshore sector: both current status and future potential. A survey of existing AI-systems in the offshore oil industry is presented. 30 refs., 1 table.

35644 **(UCRL—53859-87) Energy Program annual report.** Borg, I.Y. (ed.). (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011706/JAW.

The national economy is particularly dependent on efficient electrical generation and transportation. Electrical demand continues to grow and will increasingly rely on coal and nuclear fuels. The nuclear power industry still has not found a solution to the problem of disposing of the waste produced by nuclear reactors. Although coal is in ample supply and the infrastructure is in place for its utilization, environmental problems and improved conversion processes remain technical challenges. In the case of transportation, the nation depends almost exclusively on liquid fuels with attendant reliance on imported oil. Economic alternates—synfuels from coal, natural gas, and oil shale, or fuel cells and batteries—have yet to be developed or perfected so as to impact the marketplace. Inefficiencies in energy conversion in almost all phases of resource utilization remain. These collective problems are the focus of the Energy Program. In this report, the individual programs making up the Energy Program are grouped into three sections: Nuclear Energy, Fossil Energy, and Nonfossil Energy. Nonfossil Energy research includes work on the aluminum-air fuel cell, geothermal research, combustion chemistry, and abrasion studies relating to energy conversion processes and fuel transportation. Throughout this report, the individual programs are first described in terms of their objectives and accomplishments, and then publications reporting on the year's progress are listed.

0201 Reserves

35645 **(CMI-R—872330-3) Models for petroleum field optimization.** Haugland, D.; Hallefjord, Aa.; Asheim, H. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Sep 1987. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752811/JAW.

This paper presents some optimization models for an early evaluation of a petroleum field. Based on crude assumptions about a reservoir, our models are to suggest decisions concerning platforms capacity, drilling program and production. We start out with a simple production planning model using linear programming. By mixed integer programming techniques the model is gradually extended. The most sophisticated version of the model can propose platform capacity, where and when wells should be drilled, and the prduction from the wells. The models are tested on numerical examples, and the results are discussed. From the experiments we conclude that the problems are very hard to solve, and that the size of problems that can be solved is limited by the computational burden. Finally, we give some ideas for future work that may provide better solution methods. 16 refs., 7 figs., 1 table.

0202 Geology And Exploration

35646 **(DOE/MC/20037—T1) Arctic ice island and sea ice movements and mechanical properties: Fourteenth quarterly report, 1 January 1987-31 March 1987.** Sackinger, W.M.; Jeffries, M.O. (Alaska Univ., Fairbanks (USA). Geophysical Inst.). 1987. Contract AC21-83MC20037. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88004267/JAW.

The research program on ice islands has four elements: (1) through the use of satellite imagery, historical records, and aerial photography, to establish a time history of all of the Arctic ice shelves, and thus an historically verified source for ice islands; (2) to establish postioning buoys on the known existing ice islands to track their trajectories daily and to telemeter daily barometer pressure and temperature, via System Argos; (3) to calculate geostrophic winds from global pressure maps and barometric pressure data from the buoys, and relate the observed ice island trajectories to the winds and the internal pack ice forces; (4) to construct a model for ice island motion which will enable a determination of the probability of interaction between ice islands and offshore structures, and which will be verified by comparsion with the experimentally observed trajectory data. Research activities covered in the fourteenth quarter include; ice islands (buoy operation and ice island motion); and mechanical properties of sea spray ice bonds to structures. 2 figs., 6 tabs.

35647 **(DOE/METC—88/0260) Arctic and offshore research: Technology status report.** (USDOE Morgantown Energy Technology Center, WV). Jan 1988. 44p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001027/JAW.

This report describes the state of technology relative to the production of oil and gas in the Arctic. It discusses the technical issues that warrant investigation, and focuses on the current Department of Energy supported activities. Major accomplishments during the last year include the following: The Arctic and Offshore Research Information System (AORIS) was planned with industry survey recommendations incorporated. It contains a directory of 85 Arctic databases, a bibliographic component of over 7,000 citations, and a data component of about 300 data sets on sea ice characteristics. Seven position, pressure, and temperature buoys were deployed on ice islands (up to 3 by 6 miles in size) drifting off Ellesmere Island. Ice island movement, as much as 340 miles southwest of the Ward Hunt Ice Shelf during the last 4 years, represents a potential hazard to Arctic offshore structures in the Alaskan Beaufort Sea. The redesigned Seafloor Earthquake Measurement System (SEMS II) was deployed near Shell's Ellen-Elly platforms, about 10 miles offshore of Long Beach, California. The SEMS monitored the July 1986 southern California earthquakes. This was the first time earthquakes were simultaneously monitored by sensors located on land, aboard offshore platforms, and beneath the seafloor. Sea spray ice bond shear strength to various structural and protective coatings has been determined. The polyethylene coating demonstrated the most potential for rapid shedding of spray ice by gravity loading. Measurements of temperatures and salinities were completed as part of a pilot test to (1) detect seasonal conditions at the water-seabed interface, and (2) determine how they influence permafrost growth in the coastal waters of the Beaufort Sea. The temperatures and computed freezing point data suggest that seasonal seabed freezing can occur most of the winter. 13 refs., 14 figs., 4 tabs.

35648 **(LA-UR—88-1533) Alcohol fuel use: Implications for atmospheric levels of aldehydes, organic nitrates, pans, and peroxides: Separating sources using carbon isotopes.** Gaffney, J.S.; Tanner, R.L. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-8804137—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010952/JAW.

From CRC-APRAC methanol fuel vehicle workshop; Orange, CA, USA (19 Apr 1988).

We have developed DiNitroPhenylHydrazone (DNPH) derivatization--high performance liquid chromatographic methods for measuring aldehydes in ambient samples with detection limits of approximately 1ppbV. These methods can be used for air or precipitation studies, and have been used for indoor measurements at much higher levels using shorter integration times. We are using gas chromatographs with electron capture detection (GCECD) to measure ambient levels of peroxyacyl nitrates and organic nitrates. Diffusion tubes with synthetically produced organic nitrates in n-tridecane solution are used to calibrate these systems. These compounds are important means of transporting NO/sub x/ over large scales due to their reduced tropospheric reactivity, low water solubilities, photolytic, and thermal stability. Their chemistries are coupled to aldehyde chemistry and are important greenhouse gases as well as phytotoxins. We have completed preliminary studies in Rio de Janeiro examining the atmospheric chemistry consequences of ethanol fuel usage. The urban air mass has been effected by the direct uncontrolled usage of ethanolgasoline and ethanoldiesel mixtures. We are exploring the use of luminol chemiluminescent detection of peroxides using gas chromatography to separate the various organic and inorganic peroxides. These compounds are coupled to the aldehyde chemistry, particularly in remote chemistries downwind of urban sources. 13 refs.

35649 **(NUREG/CR—5130) Bentonite borehole plug flow testing with five water types.** Gaudette, M.V.; Daemen, J.J.K. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering). Apr 1988. 210p. NTIS, PC A10/MF A01 - GPO;1. Order Number TI88009566/JAW.

The hydraulic conductivity has been determined of plugs constructed with commercial precompressed bentonite pellets. Bentonite has been hydrated and tested with waters of five different chemical compositions, including one groundwater (Ogallala aquifer, Texas). The groundwater contained a significant amount of solids: waters prepared in the laboratory did not. Prepared waters used for testing included distilled water, a high (1000 ppM) and a low (45 ppM) calcium solution, and a 39 ppM sodium water. Uncompacted plugs were constructed by dropping bentonite tablets into waterfilled cylinders, or by mixing powdered bentonite with preselected water volumes in order to obtain controlled initial water contents. The hydraulic conductivity of all plugs tested with all waters would result in a classification of practically impervious, by conventional soil mechanics standards. Variations of several orders of magnitude of the hydraulic conductivity are observed.

35650 **(UCID—21243) Petroleum geochemistry: Annual report.** Burnham, A.K.; Braun, R.L.; Sweeney, J.J. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008973/JAW.

In recent years, integrated basin analysis has been created to address the interdisciplinary issues related to whether a trap is likely to contain oil. An important aspect of integrated basin analysis is the relationship of oil generation and destruction to time and temperature. The purpose of this project is to establish and test these relationships. A major aspect of this project is to make the necessary modifications to our oil shale kinetic models so they will be appropriate for oil exploration. Another aspect of this project is to test our chemical kinetic models in geological settings. A necessary part of this is to adapt and apply techniques for determining thermal histories of sediments. A final issue is how to properly decouple chemical and physical processes in oil generation and transport, both in the laboratory and in a basin. We are really interested in when the oil reaches our trap, geological or laboratory. Our modeling of Green River oil shale demonstrated that the principal effect of pressure was to delay the distillation of oil from the material rather than change its rate of formation. If not properly separate, mass transport effects can cause erroneous chemical reaction rate parameters, thereby compromising the extrapolation to a geological time scale. Moreover, there is an exact parallel in the generation and expulsion of oil in a geological environment. The treatment of oil evaporation in our present oil shale pyrolysis model (PYROL) is not sufficiently general to rigorously treat either the geologic case or all laboratory experiments. Therefore, part of our effort is to develop the appropriate equation-of-state treatment that can calculate the amounts and compositions of the phases present in all environments. 7 figs., 2 tabs.

35651 **(UCID—21303-88-1) Petroleum geochemistry project: Quarterly report, January-March 1988.** Braun, R.L.; Burnham, A.K.; Sweeney, J.J. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009861/JAW.

The objective of this work is to develop and test chemical kinetic models of oil generation and expulsion. The work has several components: experiments to understand the mechanisms and kinetics of oil generation, development of computer programs for analyzing experiments and applying chemical kinetics in a geological environment, and comparing predictions of chemical/geological models to field data. Some aspects of this work are part of a joint research project with INTEVEP, S.A., in which model predictions will be tested in the Maracaibo Basin. Other aspects are being done with partial support from an industrial sponsorship program that began this quarter. 1 tab.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 35647, 37070, 37071, 37352

35652 **(DOE/BC/10851—10) Dispersivity as an oil reservoir rock characterisic: Second annual report for the period October 1, 1986-September 31, 1987.** Menzie, D.E.; Dutta, S. (Oklahoma Univ., Norman (USA)). Apr 1988. Contract AC19-85BC10851. 42p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001224/JAW.

A standard technique for determining the dispersion coefficient and dispersivity has been developed in this study. By using the dispersion measurement techniques as described in this paper, the extent of unsteady mixing of a resident fluid with the injected fluid in an oil reservoir rock can be determined. Dispersivities of several Berea sandstone cores were experimentally determined and attempts were made to correlate dispersivity and dispersion characteristics with other rock characteristics. The most significant and direct relationship of the dispersion characteristics was found to exist between the dispersion coefficient and the total permeability of a core. A correlation has also been developed to correct the viscosity effect of the displacing and the displaced fluid on the dispersivity of a reservoir rock. Average grain diameters of several Berea cores were determined by sieve analysis and correlated with the dispersion coefficients and dispersivities of the corresponding core samples. The dispersion coefficients and dispersivities of the Berea sandstone cores were found to increase with the increasing grain size. 15 refs., 9 figs., 4 tabs.

35653 **(DOE/LC/11075—2554) Development of a reservoir simulator for thermal recovery of heavy oils/tar sands in the presence of gas hydrates: Annual report.** Kamath, V.A.; Godbole, S.P. (Alaska Univ., Fairbanks (USA). Petroleum Development Lab.). Sep 1987. Contract FG21-86LC11075. 249p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88001056/JAW.

This report provides the summary of work performed under the US Department of Energy, Grant #DE-FG21-86LC11075, during the past year. The report contains detailed equations, numerical solution approach for the three models, namely: fundamental hydrate dissociation model, model for layered hydrate-oil configuration, and model for distributed hydrate-oil configuration. The results of the fundamental hydrate dissociation model are provided and discussed. The other two models have been formulated and computer coded. The results of these two models will be provided in the final report.

35654 **(DOE/OGT—88/1) Advanced oil and gas recovery technologies: A current awareness bulletin.** Tamura, A.T. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jan 1988. 18p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007992/JAW.

Current worldwide information available on enhanced petroleum recovery, unconventional gas, and oil shales and tar sands is presented on a monthly basis. This publication contains abstracts of DOE reports, journal articles, conference papers, patents, theses and monographs added to the Energy Data Base (EDB) during the past month. Also included are US information obtained through acquisition programs on interagency agreements and international information obtained through the International Energy Agency's Energy Technology Data Exchange or government-to-government agreements.

35655 **(GAO/RCED—86-5) Offshore oil and gas: Inspection of outer continental shelf facilities.** (General Accounting Office, Washington, DC (USA)). 1986. 43p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

During FY 1983 the Minerals Management Service generally met its requirement to conduct scheduled annual inspections of Outer Continental Shelf facilities; however, the Coast Guard did not. Further, MMS performed some periodic unannounced inspections. MMS and the Coast Guard found few violations per facility. Although reinspection of a facility would provide added assurance that violations had been corrected, both agencies usually did not perform separate reinspections of production facilities. Drilling facilities, however, are more prone to accidents and were generally reinspected. MMS inspection frequency and scope varied because of differing regional inspection strategies and staffing. The Coast Guard did not inspect all production facilities because it did not have enough resources, particularly helicopter transportation.

35656 **(NIPER—303) Optimal rheological characteristics in dynamic stability of polymer flow through porous media: Topical report.** Gao, H.W.; French, T.R. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Apr 1988. Contract FC22-83FE60149. 28p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001225/JAW.

To identify the optimal rheological characteristics for maintaining the dynamic stability of polymer solutions flowing through porous media, displacement tests with a Newtonian fluid and a non-Newtonian fluid were performed in a 4-ft Berea sandstone core. A solution of 63 wt pct gylcerin in 53 meq/1 NaCL and a solution of 1500 ppM Pusher 500 in 53 meq/1 NaCl were used as the Newtonian fluid and non-Newtonian fluid, respectively. Two flow rates one in the purely viscous regime and one in the viscoelastic flow regime of Pusher 500 in Berea sandstone, were used in the displacement tests. The effluents collected were analyzed to determine polymer and tracer concentrations. The viscosities of the effluents were also measured with a Contraves viscometer. By comparing the concentration profiles obtained in tests with Pusher 500 and in those with gylcerin, the effects of flow rate, mobility ratio, and rheological characteristics on the dynamic stability of polymer flow in porous media were determined. At both leading and trailing edges of the polymer slug, stability increases with decreasing mobility ratio. At both high and low flow rates, a Newtonian fluid gives a more stable displacement at the fluid front than does a non-Newtonian fluid. Measurements on the mixing lengths at the back edge show that the size of the mobility buffer bank required for a flow rate at reservior conditions (viscous flow regime) would be less for a Newtonian fluid than for a non-Newtonian fluid. At a flow rate in the viscoelastic flow regime, the required size of the mobility buffer bank is less for a non-Newtonian fluid than for a Newtonian fluid. 39 refs., 13 figs., 1 tab.

35657 **(NP—8770216) Simulation model of surfactant retention. Final report.** Heinemann, Z.; Vicanek, J. (Preussag A.G. Erdoel und Erdgas, Hannover (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1986. 237p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88770216/JAW.

The ultimate oil recovery can be improved substantially by injection of proper chemicals into the oil reservoir. The most promising results were obtained using surfactants able to reduce the oil-water interfacial tension. One of the main problems causing extremely high production costs is the surfactant retention in the oil-bearing formation. Better understanding of the oil production mechanism is necessary for planning of field projects as well as for optimization of the production economics. For this reason, a numerical model was developed to simulate the fluid flow in the oil reservoir during the surfactant flooding. The computer program takes into account the phase behaviour in the crude-salt-water-surfactant system and calculates the distribution of fluids and chemicals in the threedimensional porous medium. It enables to perform history-matching of the past performance, to predict the future oil production in the field and to provide information about the surfactant consumption during the field project life. With 186 refs., 8 tabs., 32 figs.

35658 **(PB—88-182357/XAB) Reliability and availability of computer-based process safety systems - a SINTEF project.** Bodsberg, L. (SINTEF, Trondheim (Norway)). 4 Dec 1987. 31p. (STF—75-A87038). NTIS, PC E04/MF E04.

The main activities within the SINTEF research project: Reliability and availability of computer-based process safety systems (PDS) are presented. The objective of the PDS project is to identify system configurations that ensure high production regularity and at the same time comply with safety regulations, and to develop analytical models and methods for reliability predictions of computer-based systems. Some examples of redundant configurations are presented and discussed. The emphasis is on hardware redundancy and self-test techniques. Experience concerning alarm and shutdown frequencies in offshore production is also presented. At the end of the report, an approach for the incorporation of operational experience into RAM models is given.

35659 **(PB—88-197389/XAB) Hydraulic-fracture circular-geometry model. Version 1. Topical report, July 1984-August 1987.** Hanson, M.E. (Comdisco Resources, Inc., San Francisco, CA (USA)). Feb 1988. 64p. NTIS, PC A04/MF A01.

A circular hydraulic fracture model was developed for the evolution of circular hydraulic fracture. The confined geometry allowed the use of closed-form integral equations for defining fracturing in elastic media. The Barenblatt condition was used to define the unwetted length ahead of the wetted portion of the fracture. Formulations defining fluid flow in the fracture incorporate both fluid and fracture compressibility. Local fluid flux is defined using a Poiseulle relationship. Leakoff is defined by applying one-dimensional, single-phase Darcy flow. This relationship allows calculation of the change in pore pressure around the fracture due to the leaking fluid. The confined circular geometry implies fracture propagation in a uniform modulus medium under a uniform confining stress. The model allows use of either a defined-inlet flow rate or a defined-inlet pressure.

35660 **(RISO-M—2653) Simulation of end effects in relative permeability experiments.** Ladekarl Thomsen, K. (Risoe National Lab., Roskilde (Denmark)). Jun 1987. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752927/JAW.

The end effects in steady-state oil-water relative permeability measurements for a sand pack have been investigated by simulation. The exit length, which is due to capillary retention of the water, is shown to increase with decreasing flow rate and water-oil ratio (WOR). On the contrary, the entrance length increases for increasing flow rate and WOR. Thus it is important to ensure as uniform an inlet flow distribution as possible. If the two fluids are introduced via a common inlet chamber, it is necessary to assume either fingering flow, which may occur at high flow rate and WOR, or pulsating flow, which occurs at low rate and WOR. Stirring is an efficient means to reduce the entrance length. The use of a high-permeability dispersing inlet section is another method, which is also investigated.

35661 **(RISO-M—2686) COSI - Predictions and assessment of numerical performance.** Bech, N. (Risoe National Lab., Roskilde (Denmark)). Dec 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752933/JAW.

The basic reservoir simulation model, COSI, is a fully compositional isothermal double-permeability model. It is capable of handling hybrid grids as well as irregular grid cells. The simulator contains a black-oil option. The performance of the simulator has been studied in the fully compositional or multi-component equation-of-state mode. It is concluded that the results are reasonable. Calculations indicate that combustion gas injection could be an attractive enhanced oil recovery method for use in the Danish North Sea.

35662 **(RISO-M—2687) Investigation of the performance of various computers using COSI.** Bech, N. (Risoe National Lab., Roskilde (Denmark)). Dec 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752934/JAW.

The basic reservoir simulation model, COSI, is a fully compositional isothermal double permeability model. The simulator has been used to investigate the performance of different computer systems while solving typical oil reservoir simulation problems.

0204 Processing

REFER ALSO TO CITATION(S) 35717

0205 Products And By-products

REFER ALSO TO CITATION(S) 35629, 36629, 38007, 38008

35663 **(AD-A—190120/6/XAB) Turbine fuels from tar-sands bitumen and heavy oil. Volume 2. Phase 3. Process design specifications for a turbine-fuel refinery charging San Ardo heavy crude oil. Final report, 1 June 1985-31 March 1987.** Talbot, A.F.; Swesey, J.R.; Magill, L.G. (Sun Refining and Marketing Co., Marcus Hook, PA (USA)). Sep 1987. 247p. NTIS, PC A11/MF A01.

An engineering design was developed for a 50,000-BPSD grass-roots refinery to produce aviation turbine fuel grades JP-4 and JP-8 from San Ardo heavy crude oil. The design was based on the pilot-plant studies described in Phase III - Volume I of this report. The detailed plant design described in this report was used to determine estimated production costs.

35664 **(AD-A—190145/3/XAB) New method of measuring multigrade oil-shear elasticity and viscosity at high shear rates.** Lodge, A.S. (Wisconsin Univ., Madison (USA). Dept. of Engineering Mechanics). 1987. 20p. NTIS, PC A03/MF A01.

Recent journal-bearing oil-film thickness data (1) strongly suggest that, in order to develop minimum-viscosity multigrade oils for maximizing fuel economy, it is not enough to examine viscosity n alone, it is essential also to examine a certain kind of shear elasticity, of which one measure is the first normal stress difference N1 in shear flow. Within a group of isoviscous multigrade oils, N1 values can differ significantly; for 10W-40 and 15W-40 oils, an average of 75% of the minimum oil-film thickness can be attributed to N1.

35665 **(AD-A—190640/3/XAB) Effect of weathering on octane quality for winter-grade and summer-grade gasolines. Final report.** Wares, R.N. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Dec 1987. 84p. NTIS, PC A05/MF A01.

Weathering tests were conducted to examine the effects on fuel volatility and octane characteristics. The commercially available gasolines utilized in the study represented a wide geographic distribution for both winter and summer fuels. Aging was accomplished by heating the fuel samples to 110°F and maintaining that temperature for 48 hours. Time histories of Reid Vapor Pressure (RFP) were conducted. Fuel octane evaluations, both MON and RON, were done. Component characterization by gas chromatography were made to identify components lost during the aging process. The time histories of vapor-pressure changes depended to a limited measure on the initial fuel vapor pressure as well as to differences in composition. Butanes and isopentanes were the primary constituents lost due to the weathering. For the most, part octane changes due to fuel weathering were minimal.

35666 **(IEE-SR—194) Survey on development of intra-trade physical distribution of petroleum products.** Tanaka, Norio; Okaya, Yukio. (Institute of Energy Economics, Tokyo (Japan)). 15 Aug 1987. 46p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770184/JAW.

This survey is by contract with the Agency of Natural Resources and Energies of MITI. In the structural reshaping of the petroleum industry, such physical rationalization as utilization of common terminal and exclusion of complex transportation is regarded necessary. This survey is a basic information for building up a consensus of the petroleum industry by examining the most suitable distribution system by clarifying the actual status and features of distribution of rationalization. The contents examined for the third year of the 3-year plan are as follows. Comprehensive reviewing of physical distribution of the subjects to be rationalized. Status of information disposal of physical distribution business of primary oil suppliers. Future direction of information disposal of physical distribution. (12 figs, 16 tabs)

35667 **(PB—88-184205/XAB) Initial calculation of range and mission fuel during conceptual design.** Torenbeek, E. (Technische Hogeschool Delft (Netherlands). Dept. of Aerospace Engineering). Aug 1987. 29p. (LR—525). NTIS, PC E03/MF A01.

Derivations are presented for the range of aircraft with gas-turbine propulsion systems, which cannot be characterized to have either constant specific fuel consumption or constant propulsive efficiency. The effects of different cruise techniques are investigated. It is found that, for preliminary design purposes, a very simple approximation of the fuel fraction can be used for all aircraft categories and various cruise techniques. This result used to compute the total mission and reserve fuel.

0206 Health And Safety

REFER ALSO TO CITATION(S) 35658

35668 (CONF-8804108—2) A laboratory scale liquid/solid smoke generator to simulate the XM55 field system. Moneyhun, J.H.; Gayle, T.M.; Jenkins, R.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OT21400. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009711/JAW.

From 12. symposium on smoke/obscurants; Laurel, MD, USA (19 Apr 1988).

In order to conduct toxicological studies of candidate materials for the XM55 wide area obscurant generator, a generator which simulates its performance on a laboratory scale was required. A system has been designed to generate aerosols from a petroleum based liquid and a finely dispersed solid and blend the two clouds together so as to provide an atmosphere for animal inhalation toxicology studies. The liquid aerosol is generated by an evaporation-condensation process, while the solid is dispersed using a jet mill system. Concentrations of each of the components may be controlled over a range from {minus}100 mgm^3 to several gm^3. Levels of the single component aerosols are determined by gravimetric analysis of filter samples. The levels of each component of the mixed aerosols are determined by filtration, followed by uv absorption analysis of the liquid component. Particle size as determined by cascade impaction was {minus}1 micron mass median diameter for the mixed aerosols at a concentration of 1 gm^3 of each component. Mass median diameters for three individual aerosol components are {minus}0.5 and {minus}2.5 microns for the liquid droplets and solids, respectively. Significant losses of the solids to surfaces within the system have been observed, probably due to electrostatic charging of the particles. Analysis of the liquid fraction of the mixed aerosol by uv absorption indicates an increase in molar absorptivity at 255 nm, suggesting a partial chemical transformation of the liquid during aerosol generation. 6 refs., 3 figs., 4 tabs.

35669 (EMR—1987) Working the offshore safely. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1987. 36p. (In English and French). (MICROLOG—88-01281). Energy, Mines and Resources Canada, 215 Water Street, Ste. 301, St. John's, Nfld., Canada A1C 6C9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document begins with a review of Canadian offshore operations in oil and gas development since the sixties, and the role of government policy in these operations. The importance of safety in the offshore is the main topic, and discussion starts with mentioning industry-government cooperation in increasing safety factors. More specific discussion is presented on evacuation of drilling rigs, survival in the water, safety training, search and rescue operations, and the potential of satellite technology. 12 figs.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 35666, 35697

35670 (APMC—1986) Alberta Petroleum Marketing Commission annual report, 1986. (Alberta Petroleum Marketing Commission, Calgary (Canada)). 1986. 33p. (MICROLOG—88-01261). Alberta Petroleum Marketing Commission, 1900-250 6th Ave. S.W., Calgary, Alta., Canada T2P 3H7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Alberta Petroleum Marketing Commission has responsibility for selling the Crown's royalty share of Alberta's crude and synthetic oil production. It also markets crude oil on behalf of over 200 producers to North American and offshore consumers. The Commission's position as the largest crude oil marketer in Canada enables it to provide analysis of industry pricing and marketing trends to the Alberta government. In addition to crude oil activities, the Commission also provides similar services in natural gas including price regulation duties and incentive plans. This report summarizes the year's activities of the Commission and includes financial statements.

35671 (CONF-880723—1) Estimating the macroeconomic effects of world oil price projections by the US Department of Energy. Teotia, A.P.S.; Poyer, D. (Argonne National Lab., IL (USA)). 27 May 1988. Contract W-31-109-ENG-38. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011956/JAW.

From 10. annual international conference of the International Association for Energy Economics; Luxembourg, Luxembourg (4 Jul 1988).

In an environment of falling crude oil prices, the US crude oil imports reversed their decline in 1986. After hitting bottom at about 22% share of total crude oil supplies, the imported crude oil share rose to 29% in 1986 and 32% in 1987. This paper indicates that dependence on insecure foreign oil supplies is expected to grow. In the absence of any strong policy actions, the crude oil import share is projected to be in the range of 40-45% by 1995. This could have serious implications for the stable economic growth and energy security of the country. As a result, some prudent government and industry policy actions are needed to reduce the dependence on foreign crude oil before it becomes a critical problem.

35672 (DOE/EI/19926—T1) Michigan residential heating oil survey: Final report, Winter 1986-1987. Childers, G.H. Jr. (Michigan Public Service Commission, Lansing (USA)). 29 May 1987. Contract FC01-86EI19926. 24p. NTIS, PC A03;3. Order Number DE88010796/JAW.

This report summarizes information on home heating oil prices and inventories over the 1986/87 heating season in Michigan. From October through May, participating dealers/distributors were polled for their current residential (retail) and wholesale prices of No. 2 home heating oil. Primary stock (inventory) data was also collected from select bulk terminals and refineries from October through March. This information was transmitted to the US Department of Energy (DOE), Energy Information Administration, biweekly (weekly during December through February) using an electronic mail system. Michigan's participation in this program started in 1979. In addition to assisting the Energy Information Administration meet its Congressional mandate of providing an accurate and timely energy profile nationwide, the state has made valuable use of the price information by establishing its own data base using week-current figures.

35673 (DOE/EI/19930—T1) State heating oil program: Final report, September 1986-June 1987. (New York Energy Office, Albany (USA)). 29 May 1987. Contract FC01-86EI19930. 10p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010177/JAW.

The New York State average weighted price of home heating oil during the reporting period had a steady price increase compared to the previous year which had shown a major price decline. The wholesale-residential price margins remained relatively stable in New York during the 1986-87 season averaging about 35 cents per gallon. Inventory levels in primary storage were higher than the previous year but maintained the pattern of the previous year. The peak levels appeared in the mid-winter season.

35674 (DOE/EI/19931—T1) EIA(Energy Information Administration)/State No. 2 heating oil monitoring program, Minnesota: Final report, Winter 1986-87. (Minnesota Dept. of Energy and Economic Development, St. Paul (USA). Energy Div.). May 1987. Contract FC01-86EI19931. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010178/JAW.

This paper represents the final report of the Minnesota Department of Energy and Economic Development (DEED) to the Energy Information Administration (EIA), U.S. Department of Energy regarding the EIA/State No.2 Fuel Oil Monitoring Program for winter 1986-87. Prices and stocks of No.2 Fuel oil were monitored by DEED during the course of the heating season and results were sent electronically to EIA immediatley after each survey. In addition, DEED used this project to watch for any

sharp increase in heating oil prices or tightness of supplies following an oil pipeline break in Fall 1986 that disrupted supplies for northeastern Minnesota. This report presents the sampling methods, survey procedures, analysis and results of the monitoring program in Minnesota.

35675 (DOE/EI/19933—T1) State of Connecticut Middle Distillate Monitoring Program for the period July 1986-June 1987: [Final report]. (Connecticut Office of Policy and Management, Hartford (USA). Energy Div.). Jun 1987. Contract FC01-86EI19933. 31p. NTIS, PC A03;3. Order Number DE88010807/JAW.

Heating oil prices both retail and wholesale and stock levels are presented for the state of Connecticut for the period October 1, 1986 through May 4, 1987. (AT)

35676 (DOE/EI/19934—T1) Winter distillate survey, 1986-1987. (Rhode Island Dept. of Administration, Providence (USA). Div. of Planning). 29 May 1987. Contract FC01-86EI19934. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008140/JAW.

The State of Rhode Island, implemented a program to monitor prices and inventory levels of {number←sign}2 heating oil during the period October 6, 1986 to May 4, 1987. The residential and wholesale prices were collected from the same list of companies used in the 1985 to 1986 heating season. One retail seller went out of business during the year, bringing the number for which only retail prices were obtained to thirteen. Four dealers provided both retail and wholesale prices. Wholesale prices were obtained from seven sources. Thus twenty four contacts were made each week or bi-weekly, according to the schedule established by DOE, to provide the price information from the state. Distillate stocks within the state were ascertained as per the required schedule from nine sources, representing the majority of stocks. In one case, two terminals are involved and the amounts added. All data received was compiled and transmitted to DOE on time utilizing Dialcom electronic mail. 3 tabs.

35677 (DOE/EIA—0109(88/02)) Petroleum supply monthly, February 1988. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Apr 1988. 100p. NTIS, PC A06/MF A01 - GPO;1; GPO Dep. Order Number DE88009298/JAW.

Total US demand for petroleum products during February 1988 averaged about 17.6 million barrels per day, 0.9 million barrels per day above the average of a year earlier. This marks the third consecutive month in which total product supplied has exceeded 17.0 million barrels per day. For the most part, the disposition of the major products continued to follow seasonal patterns. Total products stocks dropped by 26.0 million barrels to 683.1 million barrels. Refinery utilization fell from January's 82.8 percent rate to 81.1 percent. Crude oil imports from Saudi Arabia rose to 1.2 million barrels per day, 0.4 million barrels per day above the average for January. Unusually mild weather, especially in the Mid-Atlantic states and New England, kept deliveries of both distillate and residual fuel oil virtually unchanged from January's high seasonal levels, although both were still well above the levels for these products the same time last year. Distillate demand averaged 3.5 million barrels per day in February, five percent above the February 1987 average. Residual fuel oil demand was 1.6 million barrels per day this month, nine percent greater than a year ago. Part of this increase in demand from the previous year reflects the improved competitive position of residual fuel oil in some utility and industrial markets, mostly due to increases in natural gas prices starting in the fourth quarter of 1987. 12 figs.

35678 (DOE/EIA—0109(88/03)) Petroleum supply monthly, March 1988. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 27 May 1988. 118p. NTIS, PC A06 - GPO;3. Order Number DE88011233/JAW.

Total US demand for petroleum products during March 1988 averaged 17.5 million barrels per day, about the same as in February. This is, however, 1.6 million barrels per day above the level of a year earlier. Seasonal drops in residual fuel oil and propane demand were partially offset by a rise in motor gasoline consumption. A scheduled change in tax laws affecting certain purchasers of diesel fuel kept deliveries of distillates at the same high level as in February and brought distillate stocks at the primary level to their lowest level since 1967. Other March highlights include the following: total product stocks fell 23.2 million barrels, primarily because of a big drawdown in distillate stocks; and refinery utilization increased in March to 83.5 percent. 12 figs., 33 tabs.

35679 (DOE/EIA—0208(88-25)) Weekly petroleum status report: Data for week ended, June 10, 1988. (USDOE Energy Information Administration, Washington, DC). 15 Jun 1988. 33p. NTIS, PC A03/MF A01 - GPO;1; GPO Dep. Order Number DE88011559/JAW.

The Weekly Petroleum Status Report (WPSR) provides timely information on the petroleum supply situation in the context of historical information, selected prices, and forecasts. The WPSR is intended to provide up-to-date information to the industry, the press, planners, policymakers, consumers, analysts, and State and local governments. It is published each Thursday by the Energy Information Administration (EIA). The data contained in this report are based on company submissions for the week ending 7 a.m. the preceding Friday. Contents include: refinery activity; stocks; imports; petroleum products supplied; prices; weather summary; natural gas in underground storage; weekly estimates; and appendixes. 11 figs., 16 tabs.

35680 (DOE/EIA—0380(88/01)) Petroleum marketing monthly, January 1988. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 5 Apr 1988. 183p. NTIS, PC A08 - GPO;3. Order Number DE88007995/JAW.

The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, education institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented. Monthly statistics on purchases of crude oil and sales of petroleum products are presented in five sections. These are the summary of crude oil and petroleum products, crude oil prices, sales prices of petroleum products, sales volumes of petroleum products, and first sale of petroleum products for consumption. 12 figs., 53 tabs.

35681 (GAO/RCED—87-98) Mineral resources: Timely processing can increase rent revenue from certain oil/gas leases. (General Accounting Office, Washington, DC (USA)). 1987. 18p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Federal regulations require that onshore oil and gas leases that are subsequently determined to overlie a known geologic structure are to have their rental rates increased. The Bureau of Land Management does not have internal controls that ensure that such rental increases are processed consistently and in a timely manner. Although BLM'S state offices in Colorado and Wyoming generally increased rental rates for leases determined to overlie known geologic structures, these increases were not made in a timely manner during calendar years 1984 and 1985. These delays resulted in lost revenue of $552,614. There were also a few instances in the two states in which the rental rates had not been increased at all, causing an additional revenue loss of at least $15,123.

35682 (GAO/RCED—87-180BR) Gasoline marketing: Octane mislabeling in New York City. (General Accounting Office, Washington, DC (USA)). 1987. 16p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The problem of octane mislabeling at gasoline stations in New York City has grown - from 46 or fewer citations in 1981 to 171 citations in 1986. No single source of octane mislabeling exists but the city has found both gasoline station operators and fuel distributors to blame. The problem does not seem to be unique to any one type of gasoline station but 57 percent of the 171 citations

issued involved gasoline sold under the name of a major refiner; the rest involved unbranded gasoline. Octane cheating can be lucrative in New York City. A station intentionally mislabeling its gasoline could realize amounts many times the city's maximum $500 fine for cheating.

35683 **(IEE-SR—190) Study on changes in oil supply structure in the world.** (Institute of Energy Economics, Tokyo (Japan)). 20 Sep 1987. 258p. (In Japanese). NTIS (US Sales Only), PC A12. Order Number DE88752533/JAW.

This report presents results of a study on changes in the oil supply structure in the world. The oil trade (total exports) in the free world in 1986 was 24,060,000 barrels/d, of which 83.9 percent and 16.1 percent were accounted for by raw oil and products, respectively. For raw oil, about 50 percent of the total exports was traded with its price set on the agreement basis, 26 percent on the netback price basis (mainly in the Middle East), and other portions on the spot price linkage basis and fixed-price construct basis. Equity oil traded by companies with oil interests and counter trade oil are responsible for 10 percent and 8 percent, respectively, of the total exports. Most of the exported oil is traded on some form of of agreement-based price system while spot oil accounts for only 14 percent of the total exports. OPEC and non-OPEC countries account for 66 percent and 34 percent, respectively, of the total exports. More than one-third of the OPEC oil is traded on the netback price basis. For non-OPEC countries, spot oil is responsible for 29 percent, most of which is accounted for by the Northern Sea oil. Concerning the regional classification, the Middle East is responsible for 42 percent, followed by Europe, Africa, Central/South America and Asia. (18 figs, 18 tabs)

35684 **(LBL—21186) Mexican oil balance and opportunities for conservation.** Ketoff, A.; Schiorring, E. (Lawrence Berkeley Lab., CA (USA)). Jun 1986. Contract AC03-76SF00098. 21p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008415/JAW.

Mexico's abundant oil reserves spurred the development of a highly oil-intensive domestic economy. While oil demand continues to grow despite the recession of the last four years, the recent drop in oil prices -- and therefore in export revenues -- is limiting the country's capacity to invest in new exploration. At the same time, the country's need to generate foreign exchange to pay its debt service may force an escalation in oil exports. A conflict is emerging between Mexico's need to satisfy the domestic demand for oil and its need to export oil to service the debt. In this context, an oil conservation policy appears to be the only viable alternative, although its potential will be limited by lack of capital. The sectoral analysis presented in this report identifies unexplored opportunities for energy conservation and points to the forces that will drive future patterns of demand. 18 refs., 1 fig., 8 tabs.

35685 **(NP—8752879) Oil report 1986.** (Oliebranchens Faellesrepraesentation, Copenhagen (Denmark); Oliebranchens Faellesrepraesentation, Copenhagen (Denmark)). 1987. 39p. (In Danish). Risoe Library, DK-4000 Roskilde, Denmark.

Published yearly.

A brief description is given of the international petroleum situtaion, and a survey is made of the Danish petroleum supply and of the petroleum industry in relation to e.g. new Danish governmental regulations, and the energy debate. Statistics are given of Denmarks petroleum consumption, forecasting of Danish energy consumption, the World's petroleum production, and the trend of the petroleum prices.

0208 Waste Management

REFER ALSO TO CITATION(S) 35614, 37655

35686 **(GAO/RCED—87-118) Water pollution: EPA controls over ballast water at Trans-Alaska Pipeline Marine Terminal.** (General Accounting Office, Washington, DC (USA)). 1987. 42p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Alyeska Pipeline Service Company at Valdez, Alaska, operates a water treatment plant at the terminal to treat ballast water, oily sea water that is carried in tankers to provide stability, before it is discharged into the bay. The Environmental Protection Agency is nearly 4 years late in issuing a new permit to Alyeska which regulates the types and amounts of pollution that can be discharged. Alyeska has been operating under an extension of its old permit whose conditions may be less stringent than the new permit will require. Prior to 1984, EPA monitored Alyeska's permit and identified instances of noncompliance with permit conditions, but its enforcement actions were limited to discussions and correspondence with Alyeska. In contrast, since 1984, EPA has begun taking enforcement actions as well as investigating allegations of other environmental problems. EPA should have acted sooner and until the new permit is issued, questions about the protection of marine life and water quality in Valdez Bay will remain unanswered.

35687 **(KTM/E-D—141) Flue gas desulphurization by means of improved limestone injection applied to oil firing.** Haemaelae, S.; Kenakkala, T.; Laine, J.; Mattila, K.; Vaelimaeki, E. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Sep 1984. 56p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752878/JAW.

Tightening of air protection regulations all over the world makes demands also on the availability of the SO_2 removal plant while the operating conditions in the power plant and the sulphur content of the fuel vary. In this project applying the new Lifac desulphurization process developed by Tampella to oil firing was examined at the testing unit built in the combustion laboratory of Neste Osakeyhtioe in Kulloo, where the absorbing power of calcium is improved by increasing the humidity of the flue gases. The research results indicate that this method can also be utilized at oil firing if sootblowing on the heat surfaces of the oil-fired oiler is regularly perfomed. The results also indicate that applying this process it is easy to reach the emission level of 230 mg SO_2MJ i.e. 710 mg SO_2Nm"3, which conforms to the regulations set to the new incinerators with a fuel capacity of less than 150 MW. By making the automatic control of the process more effective, the emission level of 140 mg SO_2MJ i.e. 430 mg SO_2Nm"3, which is the regulation set to the new incinerators with a capacity of more than 150 MW, is also reachable in continuous operation. The variation in the sulphur content of the oil does not restrict the availability of the process and so it also suits well for fuel with high sulphur content. When the price level of the year 1986 is applied, the total costs for desulphurization are 4 FIMMWh to 6 FIMMWh calculated for a plant firing 150 MW/sub th/ oil.

35688 **(NP—8770217) Specific emissions from a waste oil refinery.** Wentrup, G.J. (Umweltbundesamt, Berlin (Germany, F.R.)). Oct 1986. 451p. (In German). NTIS (US Sales Only), PC A20. Order Number DE88770217/JAW.

In the introduction the waste oil problem is considered and it's given a review of the level of technology for waste oil refining process. Characteristic data (e.g. density, content of water, sulfur, chlorine, chlorinated hydrocarbon, aromatic hydrocarbon) of several waste oil samples with different quality were analyzed and summarized in tables. Especially the concentration of polychlorinated biphenyls (PCB) in input-, intermediate- and output-products of the refining process were investigated. Problems in PCB-analysis of waste oil were pointed out. Specific emissions of components of environmental interest, expressed in gram per ton waste oil, were determined for storage- and product-tanks, processing units and waste-water purification plant. Additionally the influence on the specific emissions of newer refining process technologies as well as steps to decrease emission was investigated. With 219 refs., 215 tabs., 37 diagrams, 31 figs..

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 35688, 38006, 38011, 38128

35689 (PB—88-182472/XAB) Oil-spill combat in the Arctic - an alternative approach. Sveum, P. (SINTEF, Trondheim (Norway)). 29 Dec 1987. 27p. (STF—21-A87106). NTIS, PC E04/MF E04.

The main objective of the paper is to evaluate the feasibility of establishing a low-cost oil-spill strategy. This includes an evaluation of certain principles when an accidental oil spill occurs. The risk connected with the particular type of strategy should not be greater than employing conventional strategies and, if any alternative countermeasures are involved, the countermeasure should not involve more risk than the oil represents.

35690 (PB—88-183280/XAB) Treatment of oil and oily wastes. Halmoe, G. (SINTEF, Trondheim (Norway)). 8 Dec 1987. 33p. (STF—21-A87117). NTIS, PC E04/MF E04.

This paper gives a brief summary of the available methods for the treatment of oily wastes, the possibilities of each method, and their limitations. These evaluations are mainly based on the experience gained at SINTEF from disposal studies. The evaluations are closely related to Norwegian conditions, particularly with regard to shoreline types, accessibility for clean-up, and limited possibilities for incineration or recovery. Some examples are also given in the form of short summaries of the main experiments that have been carried out by SINTEF. These include laboratory-scale, model studies and full-scale experiments. For complete descriptions of the experimental parameters and results, references are given to the original reports.

35691 (Y/DZ—392) Treatability studies for waters in oil pond No. 1, oil pond No. 2, and the oil seep. Napier, J.M.; Hancher, C.W.; Harris, G.E.; Johnson, M.E.; Padgett, B.C. (Oak Ridge Y-12 Plant, TN (USA)). 3 May 1988. Contract AC05-84OS21400. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011587/JAW.

Laboratory and pilot plant studies have investigated treatment methods for water contained in 2 small ponds located at the Bear Creek burial grounds. The sediments in the bottom of the pond are contaminated with polychlorinated biphenyls (PCB) and plans to close out these ponds and remove the sediments have been prepared. These laboratory and pilot plant studies show that the water in the ponds contained no significant amounts of metals and only trace quantities of organics. The amount of PCB in the water was near the detection level. The biological quality of the water before treatment was excellent. Unit operations examined in these studies included filtration, air stripping and carbon filtration. Air stripping removed all of the trace amounts of volatile organics and carbon filtration removed all of the detectable quantities of other organics except for the low amounts of total organic carbon. Based on these tests it has been recommended that the water in the ponds be filtered and released without additional treatment through a permitted discharge point. Water from any oil seep is recommended to be collected and treated using filtration, air stripping and carbon filtration. Any water released from this process should meet the permitted discharge quality plus meet a biological test specified by the permitting agency. 2 figs., 16 tabs.

35692 The biological effects of petroleum hydrocarbons in the sea: Assessments from the field and microcosms. Spies, R.B. (Environmental Sciences Div., Lawrence Livermore National Lab., P.O. Box 5507, L453, Livermore, CA 94550 (US)). pp 411-468 of Long-term environmental effects of offshore oil and gas development. Boesch, D.F.; Rabalais, N.N. New York, NY; Elsevier Science Pub. Co. Inc. (1987).

Given our meager understanding of how marine ecosystems function and the causes of their variability, the question of whether chronic low-level petroleum contamination poses a serious threat to life in the sea is a particularly difficult one to answer completely. To the extent which we do not understand why things change in ecosystems, our answer will be incomplete-a situation which engenders various degrees of concern and motivates further research. Realizing out limitations and the variable circumstances of petroleum contamination, the aim of this review is to evaluate the results of field and microcosm studies and the extent these results allow us to predict the outcome of continued and expanded offshore petroleum extraction, transportation and related sources of contamination. Emphasis will be placed on sublittoral studies for which 1) there are extensive biological and chemical analyses, 2) effects have been suggested at very low concentrations, 3) no effects have been claimed in areas of extensive contamination, or 4) insights into critical processes or effects are evident.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 36494

0230 Properties

REFER ALSO TO CITATION(S) 35699, 35722

35693 (CMG—1201) The development of a general phase envelope construction algorithm for reservoir fluid studies. Li, Y.K.; Nghiem, L.X. (Computer Modelling Group Canada). Apr 1982. 58p. (CE—01442). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report deals with the development of a general algorithm for phase envelope constructon. It extends the pressure-temperature diagram construction method of Michelsen (1980) to the generation of phase envelopes on pressure-composition, temperature-composition and composition-composition diagrams. The bubble point and dew point curves are traced in one pass, and an estimate of the critical point is also given. The loci of mixtures having a constant vapor-liquid split (e.g. 25% vapor mole fraction or volume fraction) can also be generated. The algorithm selects internally the primary variables and the points on the diagram to enhance the convergence. Results are presented for simple binary mixtures, typical reservoir oil-CO_2 mixtures and a gas condensate. Problems associated with a discontinuity in the phase envelope because of a three-phase region are also presented, and it is shown how an analysis of the Gibbs energy surface can help in discarding unrealistic results. 20 refs., 25 figs., 3 tabs.

35694 (EPRI-AP—5826-Vol.1) Residual fuel oil user's guidebook: Volume 1, Residual oil fudamentals: Final report. Sefer, N.R.; Moulton, D.S. (Southwest Research Inst., San Antonio, TX (USA)). May 1988. 203p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011425/JAW.

Residual fuels are, by their very definition, the lowest quality petroleum fuels available: the residue that is left over after all the higher grade fuel components are removed from the crude oil. As such, they are the cheapest fuels available and therefore attractive to industries which are large consumers of fuel, e.g., refinery processing, marine, and electric utilities. Boilers, gas turbines, and diesel engines have been successfully designed to operate efficiently on residual fuel with acceptable durability and within environmental constraints. Nevertheless, problems arise that are often attributable to some critical properties of residual fuels which may vary considerably. They result in added maintenance costs, and operational interruptions either in storage and handling, or in combustion. They are generally manageable, particularly if solutions can be found based upon experience. The combined utility industry experience with residual fuel has been communicated and documented for some years by means of EPRI-coordinated meetings of utility technical and management staff. These meetings have identified the need for a practical and updatable document to which utilities staff can refer for specific information in procurement and utilization of residual fuel. This Residual Oil Users' Guidebook is intended to serve that purpose. The guidebook has been organized into four distinct subject areas: Volume I Residual Oil Fundamenals; Volume II Residual Oil-Fired Boilers; Volume III Residual Oil-Fired Gas Turbines; and Volume IV Residual Oil-Fired Diesels. Volume I is essentially a textbook on residual oil, with topics ranging from re-

sidual oil production to physical and chemical properties. Also included in Volume I is a comprehensive bibliography covering the 1973--1985 time frame.

0240 Storage

35695 **(DOE/FE—0101/1) Strategic Petroleum Reserve: Quarterly report, [January 1, 1988-March 31, 1988].** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Petroleum Reserves). 15 May 1988. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88011220/JAW.

The May 15, 1988, Strategic Petroleum Reserve Quarterly Report describes activities undertaken with respect to the development of the Reserve during the period January 1, 1988 through March 31, 1988. The introduction and summary briefly discuss program background and major activities of this quarter. Section II describes site development. Oil acquisition activities are reported in Section III. Other program topics are discussed in Section IV. Information on the budget and cost of the Reserve is contained in Section V. During the second quarter of fiscal year 1988, Strategic Petroleum Reserve storage capacity reached 580 million barrels. At Big Hill, surface construction for the remaining 9 of a total of 14 storage caverns achieved a 93 percent completion status. At Bayou Choctaw, Cavern 101 development continued on schedule. At West Hackberry, leaching operations continue on schedule toward a September 1988 completion. The total inventory of crude oil stored in the Strategic Petroleum Reserve reached 544,937,994 barrels during the quarter ending March 31, 1988. The average fill rate during the quarter was 47,140 barrels per day, and the weighted average delivered price during this quarter was $15.53 per barrel. The average fill rate for the first half of fiscal year 1988 was 60,374 barrels per day. Funds available for obligation in fiscal year 1988 include $439 million in the SPR Petroleum Account for the acquisition and transportation of crude oil and $232 million in the Strategic Petroleum Reserve Account for activities associated with storage facilities development and the operation and management of the Strategic Petroleum Reserve. 2 tabs.

35696 **(EPRI-CS—5780) Monitoring technologies for underground storage tanks: Final report.** (Weston (Roy F.), Inc., Concord, CA (USA)). Apr 1988. 137p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009904/JAW.

This five chapter report provides an introduction to available technologies for monitoring underground storage tanks (UST) for leakage. Proposed federal regulations, as well as many existing state and local laws, require UST owners and operators to install devices to enable the detection of UST releases and minimize the potential for environmental damage. This report provides sufficient information to enable the reader to become familiar with the various approaches available for UST leak detection, and to understand and select an appropriate UST monitoring system for their specific situation. Three major approaches to UST leak detection are: tank tightness testing; in-tank monitoring systems, such as automatic tank gauging systems which monitor potential inventory losses; external tank monitoring systems, such as groundwater monitoring wells, soil-gas vapor monitoring and secondary containment barriers. 49 refs., 8 figs.

35697 **(GAO/RCED—87-204FS) Oil reserves: An analysis of costs - Past, present, and future.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 21p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This fact sheet determines the total federal expenditures to date on the Strategic Petroleum Reserve per barrel of crude oil stored, with costs allocated among operations, construction, and oil; the estimated additional per-barrel expenditures of the federal government over the next 5, 10, and 15 years, allocated among the same cost categories and assuming no changes in existing federal policy on reserve levels; and in the event of an SPR drawdown, the amount any purchaser of crude oil from the SPR would pay per barrel under existing federal policy.

0250 Combustion

35698 **(EPRI-AP—5826-Vol.3) Residual fuel oil user's guidebook: Volume 3, Residual oil-fired gas turbines: Final report.** Moses, C.A.; Schwalb, J.A.; Winkler, M.F. (Southwest Research Inst., San Antonio, TX (USA)). May 1988. 104p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011426/JAW.

Volume three presents valuable information on using residual fuel oil of increasingly unpredictable quality in turbines to generate electric power. Contents include: gas turbine installation which covers components and design consideration for residual fuel; operating and maintenance procedures when using residual fuels; listing of residual fired gas turbine installations; and appendixes for code of Federal regulations and worldwide listing for residual fuel gas turbine installations. 51 refs., 20 figs., 5 tabs.

35699 **(EPRI-AP—5826-Vol.4) Residual fuel oil user's guidebook: Volume 4, Residual oil-fired diesels: Final report.** Bailey, B.K.; Winkler, M.F. (Southwest Research Inst., San Antonio, TX (USA)). May 1988. 175p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011427/JAW.

Volume four presents valuable information on using residual fuel oil of increasingly unpredictable quality in diesel engines. Contents include: residual fuel and diesel applications; fuel treatment and cleaning; engine types; engine fuel systems; operations; effects of residual oil on diesel maintenance; bottoming cycles and cogeneration; exhaust emissions; and appendix on installation listing-stationary plants utilizing residual fuels in diesel engines. 4 refs., 36 figs., 26 tabs. (AT)

03 NATURAL GAS

REFER ALSO TO CITATION(S) 35547, 35644, 36606

35700 **1986 international gas research conference: Proceedings.** Cramer, T.L. (ed.). Rockville, MD; Government Institutes, Inc. (1987). 1330p. (EN;FR). (CONF-860904—). Government Institutes Inc., 966 Hungerford Drive, #24 Rockville, MD 20850. Contract FG01-86FE61073.

From International gas research conference; Toronto, Canada (8 Sep 1986).

Individual papers are processed separately for the data bases. (PSB)

0301 Reserves

REFER ALSO TO CITATION(S) 35718

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 35647, 35654

35701 **(DOE/MC/21179—2563) Rock matrix and fracture analysis of flow in western tight gas sands: Phase 3, Quarterly technical progress report, October-December 1987.** Morrow, N.R.; Buckley, J.S.; Cather, S.M.; Brower, K.R. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). [1988]. Contract AC21-84MC21179. 18p. (PRRC—87-12). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006473/JAW.

Summary of results obtained in the last quarter are presented for the following tasks: (1) advanced core analysis which covers pore structure by uv reflectance microscopy and clay analysis of MWX cores; (2) flow along and across fractures; (3) chemical alteration of various mineralogical components and resultant effects on permeability; and (4) effect of water on gas production. 9 refs., 4 figs., 2 tabs.

35702 **(PB—88-197397/XAB) Analysis of drill core from the Siljan Ring impact structure and related processes in shear-zone terranes. Annual report, October 1, 1986-September 30, 1987.** Valley, J.W.; Komor, S. (Wisconsin Univ., Madison (USA). Dept. of Geology and Geophysics). Nov 1987. 56p. NTIS, PC A04/MF A01.

Sampling was conducted at the Siljan Ring, Sweden, on the surface from inside and outside of the ring, from drill core in pilot holes, and from drill core and cuttings in the deep Gravberg hole. Petrographic, fluid inclusion, stable isotopic, and electron microprobe analyses are underway. Thus far, these studies have not detected volatiles other than H_2O in fluid inclusions from quartz in the granite. Methane, H_2 and H_2S minimum detection limits are 3 vol. % by laser Raman and 20 vol. % optically. Isotopic analysis of calcite crack cements in granite does not confirm the prediction of Gold (1985) that delta^{13}C values would progressively decrease with depth in the Gravberg well. Instead, the results support a model where carbon is carried downward into the granite by surface water to precipitate calcite. A correlation of low delta^{13}C (< -10) near the center of the crater and higher, but variable, delta^{13}C (-19.4 to +2.2) near the annulus exists in samples from pilot holes. This may be explained if carbon in groundwater represents mixing of two reservoirs: high delta^{13}C (approximately equals 0) from Paleozoic limestones in the annulus and low delta^{13}C (-10 to -20) from organic decay.

35703 **(PB—88-203203/XAB) Exploration-production studies in newly drilled Devonian-shale gas wells. Annual technical report, February 1, 1987-January 31, 1988.** Graham, R.L.; Foster, J.; Walbe, K.; Worthington, J. (Graham (Reuben L.), Inc., Charleston, WV (USA)). Feb 1988. 74p. NTIS, PC A04/MF A01.

See also PB—87-215992; Color illustrations reproduced in black and white.

The ccoperative program is a continuing field-oriented effort whose objectives are to identify productive gas zones, to develop a comprehensive set of diagnostics, and to determine the effectiveness of various stimulation techniques. To date, the program has encompassed fifty cooperative wells and twelve participating producers, with outside funding in excess of 8 million dollars. The rapport established with these producers resulted in an evolution of the program from one of passive data acquisition to one of active participation. The report focuses on what was accomplished during this period regarding the development of diagnostic tools and evaluation techniques, the acquisition of producer participation and support, and the expansion of data acquisition and use of newly developed evaluation techniques. The report also addresses what has been learned and how this knowledge led to the course corrections in the study to achieve a more effective level of technology. The report illustrates the methods and technology developed and provides the recommended direction for future research.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 35647, 35653, 35655, 35701, 37352

35704 **(CMI-R—872325-1) Analytical solution of the gas production profile.** Asheim, H. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Sep 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752810/JAW.

The production profile for constant-volume gas reservoirs is derived from reservoir properties and well parameters. This analytical gas production profile should be preferable to existing empirical profiles. For some applications, it may also be an alternative to numerical reservoir simulations. 11 refs., 1 fig.

0304 Products And By-products

35705 **(BNL—41068) Clean carbon fuel from methane and carbon dioxide.** Steinberg, M.; Grohse, E.W. (Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012134/JAW.

Natural gas, which contains mostly methane, is generally largely available from wells in many parts of the US. Natural gas is a premium fuel, since it can be burned readily and cleanly. The main problem with methane is its storability and transportability. Pipelines are required, which if not available, are expensive to install. Methane being a cryogenic gas is not readily storable and, thus, generally must be consumed on demand. Although, at present, supply is not a problem, there is much shut-in gas wells in areas remote from pipelines and wells or gas which is of poor quality. This gas cannot be presently used without processing to a clean pipeline quality gas. The authors describe a new process that addresses the two problems of utilization and conversion of natural gas to a premium fuel based on substandard natural gas wells. The process involves the reaction of methane with carbon dioxide to produce carbon black and water.

0305 Health And Safety

REFER ALSO TO CITATION(S) 35669

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 35679, 36501, 36522, 36529, 36531, 36532, 36533, 36534

35706 **(DOE/EIA—0130(88/03)) Natural gas monthly, March 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 26 May 1988. 131p. NTIS, PC A07/MF A01 - GPO;1; GPO Dep. Order Number DE88010825/JAW.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 1982 through Feburary 1988 with monthly data for the most recent three years. Some data are also given by state or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. 6 figs., 33 tabs.

35707 **(PB—88-188867/XAB) Competitive position of natural gas: industrial frying. Topical report, December 1986-January 1988.** Minsker, B.S.; Salama, S.Y. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Jan 1988. 54p. NTIS, PC A04/MF A01.

To quantify the competitive position of natural gas in industrial frying processes, market profiles were developed to define current technologies and to characterize the applications and use of each technology in industrial-frying applications. Important cost and performance parameters were identified and validated through extensive interviews with industry representatives. Interviews also focused on current practices and fuel choice, expectations for future process developments that could affect natural gas use, and recommendations for research that could improve the effectiveness of gas-fired fryers.

35708 **(PB—88-188883/XAB) Competitive position of natural gas: industrial solids drying. Topical report, May 1985-January 1988.** Minsker, B.S.; Salama, S.Y.; Olsen, K.G. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Jan 1988. 228p. NTIS, PC A11/MF A01.

To quantify the competitive position of natural gas in industrial solids drying, market segments were developed according to technology competition issues, The drying market was segmented by feed state, drying temperature, and degree of tolerable contamination to group dryers and products with similar technology characteristics. Important cost and performance parameters were identified and validated through interviews with industry representatives. Current practices and fuel choice, expectations for future process developments that could affect natural gas use, and recommendations for research that could improve the effectiveness of natural-gas-fuel drying technologies are described in the report.

35709 **(PB—88-196381/XAB) Competitive position of natural gas: industrial baking. Topical report, December 1986-January 1988.** Minsker, B.S.; Salama, S.Y. (Gas Research Inst., Washington, DC (USA). Strategic Analysis and Energy Forecasting Div.). Jan 1988. 68p. NTIS, PC A04/MF A01.

See also PB—88-196399.

To quantify the competitive position of natural gas in industrial baking, market profiles were developed to define current technologies (single lap, tunnel, and Lanham ovens are predominant) and to characterize the applications and use of each technology in industrial baking. Important cost and performance parameters were identified and validated through interviews with industry representatives. Two areas of research that could improve technologies' effectiveness are advanced burner controls activated based on oven load that could reduce product loss, the largest coast associated with the oven, and cogeneration, which could penetrate the baking market if the high capital costs associated with existing equipment could be reduced.

35710 **(PB—88-196399/XAB) Competitive position of natural gas: drying of paints and coatings. Topical report.** Holmes, J.G.; Duleep, K.G.; Olsen, K.G. (Gas Research Inst., Washington, DC (USA). Strategic Analysis and Energy Forecasting Div.). Mar 1988. 183p. NTIS, PC A09/MF A01.

See also PB—88-196381.

This study provides insights into the important technological and economic factors influencing the future competitiveness of natural-gas-fueled paint drying technologies. The report focuses on the performance factors influencing fuel and oven selection, and relates these performance factors to the capabilities of existing gas-fired equipment and to the requirements likely to be placed on new gas technologies. Four applications were selected for detailed case studies: beverage can coatings, coil coatings, automobile paints, and appliances paints. At current energy prices, natural gas is the primary choice for drying of paints and coatings in most applications. In the future, factors other than energy prices will become more important in fuel choice. For example, control of volatile organic compound (VOC) emissions and process control flexibility and startup/shutdown are important factors in some applications.

35711 **(PB—88-197157/XAB) Assessment of opportunities for gas-fired sintering in the advanced-ceramics and powdered-metals industries. Topical report, June 1986-May 1987.** Messing, G.L.; Koss, D.A. (Pennsylvania State Univ., University Park (USA). Center for Advanced Materials). Jun 1987. 43p. (CAM—8702). NTIS, PC A03/MF A01.

Almost the entire ceramics industry and a portion of the metals industry rely on the use of high temperatures to effect densification of powder preforms (sintering). Many of these materials are sintered in electrically heated furnaces. The development and implementation of gas-fired heating systems in these growing industries could potentially increase natural gas usage. The project was designed to determine the technical requirements for gas-fired sintering technology in these industries and to assess the potential for implementing such a technology.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 35654, 35659, 35703

35712 **(DOE/RA/33101—2551) Demonstration projects for coalbed methane and Devonian shale gas: Final report.** Verrips, A.M.; Gustavson, J.B. (Gustavson Associates, Inc., Boulder, CO (USA)). Apr 1987. Contract FG21-79RA33101. 38p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001053/JAW.

In 1979, the US Department of Energy provided the American Public Gas Association (APGA) with a grant to demonstrate the feasibility of bringing unconventional gas such as methane produced from coalbeds or Devonian Shale directly into publicly owned utility system distribution lines. In conjunction with this grant, a seven-year program was initiated where a total of sixteen wells were drilled for the purpose of providing this untapped resource to communities who distribute natural gas. While coalbed degasification ahead of coal mining was already a reality in several parts of the country, the APGA demonstration program was aimed at actual consumer use of the gas. Emphasis was therefore placed on degasification of coals with high methane gas content and on utilization of conventional oil field techniques. 13 figs.

35713 **(SAND—87-3056C) Stimulation-fluid systems for naturally fractured tight gas sandstones: A general case study from multiwell experiment stimulations.** Sattler, A.R.; Raible, C.J.; Gall, B.L.; Gill, P.J. (Sandia National Labs., Albuquerque, NM (USA); National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA); Dowell Schlumberger (USA)). 1988. Contract AC04-76DP00789. 31p. (CONF-880624—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009694/JAW.

From SPE gas technology symposium: gas supply - a critical balance of politics, the market place, and technology; Dallas, TX, USA (13 Jun 1988).

Extensive production testing and core analyses show that prestimulation production from the low-permeability sandstones in the Mesaverde formation at the Department of Energy's Multiwell Experiment (MWX) field laboratory is dominated by natural fractures. Experience gained during MWX stimulations in these tight Mesaverde reservoirs strongly suggests that damage to the narrow natural fractures is an important factor affecting poststimulation production. This paper summarizes the field data showing both evidence for production from natural fractures and evidence for interactions between natural fractures and stimulation fluids resulting in decreased gas production. The nature of these interactions is clarified through a description of laboratory studies dealing with the degradation of the stimulation fluids and with the permeability damage of artificially fractured core exposed to the stimulation fluids. Evidence is very strong that damage from stimulation fluids to the narrow natural fractures restricted the production of gas in early MWX stimulations, a hypothesis that is consistent with the partial reversibility of fluid damage in the natural fractures of one zone following a long-term shut-in. A controlled breaker system was designed for use with the relatively clean, temperature-stable biopolymer foam. Use of this fluid system in a later MWX stimulation substantially increased gas production and reduced evidence of damage. 48 refs., 11 figs., 8 tabs.

0320 Transport, Pipelines, And Handling

35714 **(PB—88-202635/XAB) Effectiveness of cathodic protection. Phase 3. Final report, March 1983-June 1984.** Ruck, G.T.; Walcott, K.J.; Thompson, N.G.; Barlo, T.J. (Battelle Columbus Div., OH (USA)). Nov 1985. 100p. NTIS, PC A05/MF A01.

See also PB—87-181962.

Cathodic protection is one method used to control corrosion on buried gas-distribution piping. Proper interpretation of the level of cathodic protection requires appropriate correction or compensation be made in the pipe-to-soil potential for errors from IR drop in the soil and from stray AC and/or DC interferences. A microprocessor-based prototype instrument to make this correction on piping protected by impressed-current systems was designed, fabricated, and evaluated in the field. The instrument performed as designed, however modification is required before final design. An unexpected spike or transient in the pipe-to-soil potential waveform from some rectifiers interferred with accurate polarized potential measurements in many cases. Future software modifications are expected to identify and accurately treat most of these situations and improve AC rejection. Commercialization appears to be economically feasible. Laboratory experiments have demonstrated that the AC-impedance techniques appear to be feasible to assess the corrosion rate of unprotected steel, and the corrosion state of buried steel protected by either impressed-current or sacrificial-anode systems. Two AC impedance parameters that correlate well with the corrosion state have been identified. An instrument design concept embodying this technique for buried piping has been developed and further research and development is planned.

35715 **(PB—88-202676/XAB) Development of an equation of state for computation of supercompressibility factors, critical flow factors, and other properties for wet, sour natural gases, synthetic gases, and admixtures. Final report, October 1984-September 1987.** Starling, K.E.; Mannan, M.; Savidge, J.L.; Sadasivan, S.; Reid, T.B. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). Sep 1987. 217p. NTIS, PC A10/MF A01.

See also PB—87-209987.

The research effort has extended the highly accurate compressibility/supercompressibility factor correlation for sweet/dry natural gases developed in 1981-1984 to include water and hydrogen sulfide. In the temperature and pressure range where most custody transfers take place, the correlation is accurate within 0.1% or better in the supercompressibility factor. One of the conclusions reached in the work is that a more-extensive high-quality PVT data base for wet/sour natural gases is needed to further test the correlation. The revised alternate characterization methods developed in the work allow faster and simpler calculations resulting in large reductions in computer time when compared with the alternate characterization methods presented in A.G.A. Report No. 8. The prediction accuracies for these methods are comparable or slightly better than the A.G.A. Report No. 8 alternate characterization methods. As compared to the A.G.A. Report NX-19 alternate characterization methods, the methods developed in the work require similar computer time, while giving dramatically more accurate results. The equation-of-state method has been applied for prediction of highly accurate sonic velocities and critical flow factors for use with sonic nozzles. The prediction of the sonic velocity is shown to be generally accurate within plus or minus 0.1% at reasonable operation conditions for sonic nozzles. The prediction of critical flow factors is also shown to be more accurate than the Johnson method.

0330 Properties

REFER ALSO TO CITATION(S) 35654

35716 **(PB—88-196407/XAB) New methane chemistry synthesis of materials for reversible uptake and useful functionalization of methane. Annual report, January-December 1987.** Green, M.L.H. (Oxford Univ. (UK). Inorganic Chemistry Lab.). Jan 1988. 17p. NTIS, PC A03/MF A01.

New intercalation compounds of organometallic guest molecules and layer metal oxides and sulfides are described. Oxidative coupling of methane to ethylene and ethane over silica catalyst has been demonstrated in preliminary studies. A comprehensive review of carbon-hydrogen-metal bonds has been published. These bonds are fundamental in methane-activation processes.

0340 Combustion

REFER ALSO TO CITATION(S) 36608, 36710, 37405

35717 **(PB—88-203179/XAB) Advanced refinery process heater. Annual report, October 1986-September 1987.** Minden, A.C.; Kennedy, J.M. (Alzeta Corp., Santa Clara, CA (USA)). Oct 1987. 34p. (ALZETA—87-711-139). NTIS, PC A03/MF A01.

See also PB—87-163572.

During the fourth year of the project, the design of the heater and its associated oil-cooling-loop miniplant was finalized and installation initiated. Delays in obtaining construction and new source emissions permits led to delays in installing the heater system at the Evergreen Oil Co. field test site. The burner assembly design was finalized and successfully tested. Installation at the field-test site is scheduled to be completed by December, 1987. A paper was presented at the 14th Annual Energy Technology Conference detailing the design of the heater, and two patents were issued covering the heater design and the use of Zone-Controlled Pyrocore burners.

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 35547, 35644, 35654

0401 Reserves And Exploration

35718 **(DOE/FE—8010424) Plan for protection of oil and natural gas resources Naval Oil Shale Reserve No. 1 and No. 3, Garfield County, Colorado.** (USDOE, Washington, DC). Oct 1987. 33p. NTIS, PC A03;3. Order Number DE88010424/JAW.

This plan provides for the protection of the Government's interest in hydrocarbons found in Naval Oil Shale Reserve No.1 (NOSR-1) and Naval Oil Shale Reserve No. 3 (NOSR-3) located in GArfield County, Colorado, and complements a similar plan developed in 1983. Recent development of private property near NOSR-3 exceeds the activity contemplated in the 1983 plan, and has progressed to drilling units on land which, under Colorado spacing orders, would include at least 50 percent NOSR-3 land. Due to the proximity of these commerical gas wells to NOSR-3 land, it is estimated that gas produced from the wells would include gas which had migrated from NOSR-3. To protect the Government's interest in these and other such wells which may be drilled near NOSR-1 or NOSR-3, the Department's plan of primary protection is to enter into communitization agreements with the private developers when they initiate wells which would drain NOSR-1 or NOSR-3 hydrocarbons. In general, these agreements would permit the sharing of costs and hydrocarbon production based on surface acreage owned by each party in each of the drilling units. If attempts to obtain such agreements fail, or if it is determined that offset wells are needed in addition to the communitized units, the Department plans to drill and produce wells on NOSR-1 and NOSR-3 which would offset production from nearby wells on private lands. These measures will preclude the migration of NOSR-1 and NOSR-3 hydrocarbons to privately-owned wells, and protect the Government's resources. The results of the Department of Justice anti-trust review performed pursuant to Section 7430(g) of title 10, United States Code, are provided as a part of this plan at Exhibit N.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 35653

35719 **(DOE/MC/11076—2449) Mathematical comparisons with the inclined fluidized bed retort.** Mones, C. (Western Research Inst., Laramie, WY (USA)). Nov 1987. Contract FC21-86MC11076. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006022/JAW.

A one-dimensional oil shale retorting model was used to simulate inclined fluidized bed retorting of western oil shale. The calculated oil yields agree fairly well with data from previous experiments because the stoichiometry and kinetics of western oil shale pyrolysis do not depend strongly on heating rate. Although the model produces acceptable results with western shales, an understanding of the retorting mechanism for eastern shales at high heating rates is necessary to properly predict oil recoveries under fluid bed conditions. 6 refs., 3 tabs.

35720 **(DOE/MC/22134—2539) Fluidized-bed retorting of Colorado oil shale: Topical report.** Albulescu, P.; Mazzella, G. (Foster Wheeler USA Corp., Clinton, NJ). Jun 1987. Contract AC21-86MC22134. 594p. NTIS, PC A25;3. Order Number DE88001036/JAW.

In support of the research program in converting oil shale into useful forms of energy, the US Department of Energy is developing systems models of oil shale processing plants. These models will be used to project the most attractive combination of process alternatives and identify future direction for R & D efforts. With the objective of providing technical and economic input for such systems models, Foster Wheeler was contracted to develop conceptual designs and cost estimates for commercial scale processing plants to produce syncrude from oil shales via various routes. This topical report summarizes the conceptual design of an integrated oil

shale processing plant based on fluidized bed retorting of Colorado oil shale. The plant has a nominal capacity of 50,000 barrels per operating day of syncrude product, derived from oil shale feed having a Fischer Assay of 30 gallons per ton. The scope of the plant encompasses a grassroots facility which receives run of the mine oil shale, delivers product oil to storage, and disposes of the processed spent shale. In addition to oil shale feed, the battery limits input includes raw water, electric power, and natural gas to support plant operations. Design of the individual processing units was based on non-confidential information derived from published literature sources and supplemented by input from selected process licensors. The integrated plant design is described in terms of the individual process units and plant support systems. The estimated total plant investment is similarly detailed by plant section and an estimate of the annual operating requirements and costs is provided. In addition, the process design assumptions and uncertainties are documented and recommendations for process alternatives, which could improve the overall plant economics, are discussed.

35721 **(UCRL—98064) Isothermal pyrolysis and char combustion of oil shales.** Coburn, T.T.; Taylor, R.W.; Morris, C.J.; Duval, V. (Lawrence Livermore National Lab., CA (USA)). 3 Feb 1988. Contract W-7405-ENG-48. 9p. (CONF-880589—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010709/JAW.

From International conference on oil shale and shale oil; Beijing, China (16 May 1988).

Yields and rates of hydrocarbons evolved during pyrolysis of oil shales have been measured with improved accuracy. Green River and New Albany oil shales were heated in a fluidized sand bed, and volatile pyrolysis products were transferred to a combustion tube and burned. Resulting H_2O and CO{sub 2 were detected in real time by mass spectrometry. Residual char was subsequently burned to allow complete C and H balances. Good closure was obtained. Proportions of organic C and H released as pyrolysis products and retained as char were determined. Shale oil loss due to the presence of oxidized shale in the fluidized bed was measured accurately. We find that all of the experimental apparatus that the pyrolysis gas contacts must be near pyrolysis temperature to avoid condensation of heavy oil which subsequently forms coke and secondary products. We observe a faster release of products with all transfer lines 450{degree}C than when they are at 300{degree}C. The current uncertainty in pyrolysis rates is due in part to such difficulties with experimental techniques. 12 refs., 7 figs., 1 tab.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 35720

35722 **Analysis of polynuclear aromatic hydrocarbons in shale oil and diesel particulates.** Tan, Y.L. (Dept. of Energy, New York, NY (USA)). *Analytical Letters;* 21: No. 4, 553-562(Apr 1988).

The authors participated in the interlaboratory studies conducted by the National Bureau of Standard/Department of Energy (NBS/DOE) Analytical Characterization Group in which shale oil and diesel particulates were analyzed for three ring to six ring polynuclear aromatic hydrocarbons (PAH). Diesel particulates were extracted by Soxhlet or ultrasonic extraction. The PAH fraction was isolated with Sephadex LH-20 gel filtration chromatography and silica gel adsorption chromatography. The individual PAH was identified and quantitated with a gas chromatography/flame ionization detector and computerized gas chromatography/mass spectrometry. The combination of gel filtration and adsorption chromatography was found to be effective in isolating PAH from various complex sample matrices for further instrumental analysis. The results compared favorably with methods used among the other participating laboratories.

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 35663

0408 Marketing And Economics

REFER ALSO TO CITATION(S) 35720

0409 Waste Research And Management

35723 **Ammonia evolution during oil shale pyrolysis.** Oh, M.S.; Taylor, R.W.; Coburn, T.T.; Crawford, R.W. (Lawrence Livermore National Lab., CA (USA)). *Energy and Fuels;* 2: No. 1, 100-105(Jan-Feb 1988). Contract W-7405-ENG-48.

Ammonia ((NH_3)) evolution during pyrolysis of three Green River Formation shales and one Eastern (Devonian) shale was studied. The yields of NH_3 from Fischer assay type experiments were measured with an NH_3-sensing electrode, and the time-dependent rate of NH_3 evolution was measured with a triple-quadrupole mass spectrometer. We varied the peak temperature (PT) of the pyrolysis from 350 to 750 2{C and the heating rate from 1 to 50°C/min. The NH_3 yields increased rapidly above the oil-generating temperatures to a maximum at PT $\sim$ 700°C and then decreased at PT $>$ 700°C because of the decomposition of NH_3. The NH_3 yield showed no dependence on the heating rate at PT $<$ 550°C and decreased with increasing heating rate at higher peak temperatures. For Green River Formation shales, the yield of NH_3 at PT $<$ 500°C reflected the organic nitrogen content. The extent of NH_3 decomposition varied with gas environments, solid surface, and the conditions of the retort can. Because steam works as an inhibitor for the decomposition reaction, we used steam as a retorting gas to obtain the total yield of NH_3. We developed a kinetic model for NH_3 evolution; it takes into account NH_3 generation from organic and inorganic nitrogen sources and NH_3 decomposition.

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 35861

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 36494, 38153

35724 **(CANMET-SS—1) Minerals, metals and mining technologies. Minerals processing-research and development.** Sirois, L.L.; MacDonald, R.J.C. (eds.). (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Dec 1983. vp. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780077/JAW.

Selected papers were processed for inclusion in the Energy Data Base.

35725 **(FRCEA-TH—65) Hydrogeochemistry of uranium, daughter products and associated elements (lanthanides), application to ore prospection.** Toulhoat, P. (Paris-6 Univ., 75 (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee et d'Etudes Analytiques). Sep 1987. 297p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88753966/JAW.

The behavior in ground water of uranium, daughter products with long half life (U^{234}, Th^{230}, Ra^{226}) and stable (radiogenic lead) and lanthanides is studied by two complementary methods: 1) In situ multielement tracing in fracturated granitic rocks and porous sedimentary rocks of low permeability allowing to understand interactions between hydrodynamics and geochemistry. 2) Study of the properties of U^{234} and Pb^{210} which are mineralization tracers and are relatively independent of redox conditions, on the contrary U 238 has a low solubility in reducing medium. Three areas are studied: Bazois and Lodeve basin (France) and Cigar Lake

(Canada). Radioactive disequilibriums are thoroughly studied when required by orerock interaction. Adsorption-desorption phenomena are of great importance in proposed prospection models. If prospection models based on alpha activity ratio $U^{234}U^{238}$ and lead isotope ratio in ground water can be applied, an integrated prospection model requires more in situ and laboratory experiments.

35726 (GSCan-P—85-1B, pp 23-31) **Uranium and other trace and minor element concentrations in surface rocks and stream sediments from the Cypress Hills, Saskatchewan.** Dyck, W.; Bell, R.T. (Geological Survey of Canada, Ottawa, Ontario). 1985. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780080/JAW.

In Current research.

Surface rock samples from traverses of two buttes and a clay pit in the Cypress Hills near Eastend, Saskatchewan were collected and analyzed for 27 trace and minor elements. The results show that most trace elements, particularly U, are markedly enriched in some coaly layers relative to others and the other rocks of the formations in general. U concentrations of up to 1200 ppm were encountered in seams in the Ravenscrag Formation of Anxiety Butte. Excess U, relative to its daughter Ra, in one coaly layer suggests that U is accumulating or Ra depleting at a faster rate than its homologue; in another the reverse phenomenon was observed.

35727 (INIS-BR—1093) **Estimation grade of uranium from drill hole gamma logs.** Juliao, B. (NUCLEBRAS, Rio de Janeiro (Brazil)). 1986. 12p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702790/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

Radiometric grade of uranium deposits can be determined from drill hole gamma logs. The calculation of uranium oxide content can be obtained with good precision when the uranium ore is in radioactive equilibrium, containing only a small amount of thorium and no interference of potassium. This is the case of uranium ore from the Lagoa Real Uranium Province presented in this paper. The radioactive disequilibrium study in this province were made working over nine hundred samples analised with this special purpose in the CDTN-NUCLEBRAS laboratories. The data obtained indicated that the uranium in the ore is in perfect equilibrium with their daughter gamma emitters. Futhermore, the amount of Th and K is of no significance, so that the gamma counting represents exactly the uranium content of the ore.

35728 (INIS-BR—1096) **Itataia ore deposit - Caracterization of the massif according alteration/argilization and estimation of material volume inside a pit.** Alcantara e Silva, J.R. de. (NUCLEBRAS, Fortaleza (Brazil)). 1986. 15p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702792/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

This paper sumarizes the geotechnically characterization of the Itataia ore deposit according to the relationship rock alteration/argilization. Through this charaterization it was defined three types of material related to the degree of alteration and argillization: Type I (fresh or pratically fresh and little or monargillized material); Type II (partially altered and argillized material). The new geological syntesis and iformation, together with seismic parameters allowed to a material classification according to the scarificability, and important factor in the costs of an open pit mine.

35729 (INIS-BR—1097) **Itataia's deposit - Structural zoning of a pit until the level 480 meters.** Mendonca, J.C.G.S. (NUCLEBRAS, Fortaleza (Brazil)). 1986. 9p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702793/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

This work is part of Itataia Project-Geotechnics; in it are introduced several comments concerning the structural zoning of a pit in Itataias' phosphorous-uranipherous deposit, until the level 480 meters. The structural parameters (fractures, faults, foliations) obtained in surface and underground works were statistically treated. Stereographic projection was used to define eventual slipping into the pit. All the data were arranged in tables to make it easy the comparison with experimental pits.

35730 (INIS-BR—1098) **Uranium occurence in the Rio Cristalino area, South of Para.** Andrade, S.M. de; Ribeiro, E.; Camarco, P.E.N.; Puppin, C.; Santos Filho, J.L. dos. (NUCLEBRAS, Goiania (Brazil)). 1986. 15p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702794/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

The Rio Cristalino area where occurs uranium mineralization is located in the Western part of the Santana do Araguaia Town, Para State. This area comprises 1.350 Km^2, and was selected from the evolution of the 'Projeto Geofisico Brasil - Canada - PGBC'. According to the results obtained from this Project, 15 airbone anomalies were selected for ground check. In the anomalies AN-03 and H-09 were found the best uranium occurence. The host rocks consist of arkose and sandstone of Pre-Cambriam ages, which show a very low-grade of metamorphism. The primary mineralization occurs in arkose along the cataclastic foliation (N70°W 65°NE). The secundary mineralization involves clay galls and fills fracture zones in sandstone of the anomaly H-09. The highest grade detected in a rock sample of the anomaly AN-03 was 6,1% U_3O_8, whereas in the trenches there are intervals of 6 m thickness with a grade of 0,59% U_3O_8. Based on some mineralization aspects and field data, the genetic conceptual model to the uranium mineralization is proposed.

35731 (INIS-BR—1099) **Itataia's phosphorous-uraniferous deposit - Alteration and argilization influence in physical processing of the mineralized lithologies.** Rosa, C.V. (NUCLEBRAS, Fortaleza (Brazil)). 1986. 15p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702795/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

This study was developed by NUCLEBRAS, firstly defining the quality and quantity of the Itataia ore body untill the 480 m level of the future pit, considering the lithological types, the P_2O_5 and U_3O_8 contents and the alteration and argillization of the rocks. The following step was to establish the physicochemical character of the mineralized lithologies according to the phases of alteration-argillization. Finally it was compared the results of these two stages with the results of the pilot treatment, related to the gangue in the phosphoric acid concentrate. The method showed the difficulties in each host rock, differently alteredargillized for future process and allowed to the identification of seven types of material to supply the Itataia pilot plant.

0504 Feed Processing

REFER ALSO TO CITATION(S) 35724

35732 (INIS-BR—1095) **Isotope disequilibria 4n series in the Morro do Ferro System, Pocos de Caldas (MG).** Bonotto, D.M.; Fujimori, K. (UNESP, Rio Claro (Brazil). Inst. de Geociencias e Ciencias Exatas). 1986. 15p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702869/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

Thorium isotopic analyses were performed on well spoils of the main ore body at Morro do Ferro, Pocos de Caldas (MG), on groundwaters from several boreholes in the area and surface waters from a stream that originates at the base of the hill. For extraction of thorium a long chemical process was applied to samples; activities of Th-228 and Th-232 isotopes (4n series) were determined by alpha spectrometry method. The rations Th-228/Th-232 determined for well spoils did not show marked disequilibria between these isotopes. In ground and surface waters, the ratios Th-228/Th-232 showed marked isotopic fractionation between these nuclides, not related to selective leaching of Th-228 in relation to Th-232 or recoil of Th-228 nucleons.

35733 **Plutonium aerosol generation in reducing and oxidizing atmospheres at high temperatures.** Eidson, A.F.; Yeh, H.C.; Kanapilly, G.M. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). *Journal of Nuclear Materials;* 152: No. 1, 41-52(Mar 1988). Contract AC04-76DP00789;W-7405-ENG-48;W-7405-ENG-36;AC04-76EV01013.

Delta-phase plutonium metal pellets and foils were heated at 450°C in reducing atmospheres (3% H_2 + 97% Ar or 3% H_2 + 5% N_2 + 92% Ar), and the respirable aerosols were collected and characterized. Residues of plutonium hydriding reactions were also heated at 450°C in air. The percentages of initial radioactivity released as respirable aerosols under hydriding or oxidizing conditions were not significantly different. Surface area to mass ratio was not a significant factor, nor was linear gas flow velocity between 40 and 1000 cm s^{-1}. The average percentage of initial radioactivity generated as respirable particles was 0.021% with a worst-case value of 0.46%. These percentages agree with those of previous research in which only air or O_2 and N_2 mixtures were used in a static reaction, and are significantly less than those generated by particles freely falling in air. The activity median aerodynamic diameters of the various aerosol size distributions were variable, but ranged from 4 to approximately 10 μm. The mass median diameter of powdered residues was highly variable, ranging from 4 to > 350 μm. The particle size distribution of aerosols or powder residues was not related to the types of reaction atmosphere studied. These results support the conclusion that the major factors influencing the amount of particulate residues and their particle sizes are those that influence the integrity of a protective oxide layer, rather than the reducing or oxidizing nature of the reaction atmosphere.

0505 Uranium Enrichment

35734 **(ES/ESH—4/V4) Environmental surveillance of the US Department of Energy Portsmouth Gaseous Diffusion Plant and surrounding environs during 1987.** Aaron, M.R. (ed.); Rogers, J.G.; Wiehle, W.E.; Valentine, B.L.; Acox, T.A.; Goslow, G.A.; Bracknell, A.K.; Homerosky, F. Jr.; Timmons, G.A.; Strange, R.A. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Martin Marietta Energy Systems, Inc., Piketon, OH (USA)). Apr 1988. Contract AC05-84OR21400. 226p. (POEF—1180). NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88010749/JAW.

This report consists of two parts: summary, discussion, and conclusions (Part 1) and data presentation (Part 2). The objectives of this report are the following: Report 1987 monitoring data for the installation and its environs that may have been affected by operations on the plant site. Provide reasonably detailed information about the plant site and plant operations. Provide detailed information on input and assumptions used on all calculations. Provide trend analyses, where appropriate, to indicate increases and decreases in environmental impact. Provide general information on plant quality assurance. Routine monitoring and sampling for radiation, radioactive materials, and chemical substances on and off the DOE site are used to document compliance with appropriate standards, identify trends, provide information for the public, and contribute to general environmental knowledge. The surveillance program assists in fulfilling the DOE policy of protecting the public, employees, and the environment from harm that could be caused by its activities and reducing negative environmental impacts to the greatest degree practical. Environmental monitoring information complements data on specific releases, trends, and summaries.

35735 **(K/ITP—172) Development of a 20-ton-capacity load-cell-based weighing system for IAEA [International Atomic Energy Agency] field use.** Cooley, J.N.; Huxford, T.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA). International Technology Programs Div.; Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OT21400. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009774/JAW.

A 20-ton-capacity Load-Cell-Based Weighing System (LCBWS) is being developed to provide the International Atomic Energy Agency (IAEA) with a portable means of verifying the masses of 10- and 14-ton UF_6 cylinders at UF_6-bulk-handling facilities subject to IAEA safeguards inspections. The system is being designed to meet IAEA objectives for portability and accuracy as well as to meet facility operating safety conditions. During the development effort, system design requirements were established, and a comprehensive survey of commercially available weighing equipment against these requirements was conducted. Detailed equipment specifications for 20 load cells from 13 manufacturers, for 5 digital crane scales from 3 manufacturers, and for 7 digital weight indicators from 5 manufacturers were compared. The results of the survey favored a configuration based on a custom-designed load cell integrated with a commercially available digital weight indicator. Safety certification of the system by an internationally recognized verification authority is also recommended. Comparison criteria and their effect on the LCBWS design requirements are discused,and the status of the project is reported. 2 refs., 2 figs., 2 tabs.

35736 **(K/QT—141) Development of the simplified compressor model (SCM) for performance analysis of gaseous diffusion compressors.** Baker, S.T. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Oct 1987. Contract AC05-84OT21400. 22p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009066/JAW.

This report documents the progress on the FY 87 K-site Milestone (for the Process Equipment and System Performance (PESP) team of the Process and Long Range Technical Support (P&LRTS) program) which calls for the formulation of "simplified compressor performance prediction codes for use in GDP cascade models." In particular, the features, benefits, steps in the development, and results of a simplified compressor model (referred to as the SCM) for predicting the off-design performance of compressors used in the gaseous diffusion process are discussed. Calculations for the T7 compressor were performed at 1700 hp and at discharge temperatures of 265{degree}F, 290{degree}F, and 315{degree}F (these temperatures representing all temperatures at 1700 hp for which experimental data is available). The results of these calculations are shown in Figures 8--10. Note that the SCM does a much improved job in predicting the efficiency and A-stream volume flow rate than the larger, more complex code, DYNADEC. Agreement between test data and the SCM calculations for static pressure ratios and B-stream equivalent volume flow is comparable to that obtained by DYNADEC. Each set of four performance maps required approximately one minute of CPU on a VAX 8600 using the SCM (compared to nearly one hour of CPU using DYNADEC). 10 figs.

35737 **Competitiveness through change: institutional restructuring of the United States uranium enrichment enterprise.** Longenecker, J.R. (Department of Energy, Washington, DC (USA). Office of Uranium Resources and Enrichment). pp 280-291 of Uranium and nuclear energy: 1986. Proceedings of the 11. international symposium held by the Uranium Institute, London, UK, 2-4 September 1986. London, England; Uranium Institute (1987). (CONF-860915—).

From 11. annual symposium of the Uranium Institute; London, UK (3 Sep 1986).

The position of the United States programme of uranium enrichment under the Department of Energy is explained. Its competitiveness has improved over the past few years by normalising supply and demand and by streamlining the costs of gaseous diffusion plant production. The historical aspects of the uranium enrichment service are explained. Revised criteria to describe the guidelines to cover pricing, contracting and other crucial functions are under discussion. Two aspects of the new criteria of particular interest -restrictions on foreign-origin uranium and recovery of Government costs - are noted. Possible private sector involvement in uranium enrichment is discussed. Technological innovations are explained and equipment illustrated. These should improve the industry's competitiveness. (U.K.).

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 35888, 36202, 36260, 36776, 36843, 36847, 37029, 37030, 37056, 37190, 37200, 37769, 38523, 38574, 38580, 38601, 38602

35738 Determination of isotopic ratios from fuel burnup. Lee, J.C.; Hsue, S.T. (The Univ. of Michigan, Dept. of Nuclear Engineering, Ann Arbor, MI (US)). *Nuclear Technology;* **76**: No. 2, 203-208(Feb 1987).

Based on a simplified solution of the balance equations for concentration of uranium and plutonium isotopes and a set of two-group microscopic cross sections, isotopic ratios, /sup 235/U/U, Pu/U, and /sup 239/Pu//sup 235/U, are calculated as a function of fuel burnup for pressurized water reactor spent fuel. The two-group cross sections for /sup 235/U, /sup 238/U, /sup 239/Pu, and water are collapsed into equivalent thermal-group constants, with the fast-to-thermal flux ratio obtained through a two-group criticality consideration. For this purpose, parasitic neutron captures are represented through a simple semiempirical relationship. The calculational model, incorporated as the BURN code, yields isotopic ratios that compare favorably with three major data sets from the ISTLIB data bank.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 35794, 35849, 35890, 36258, 36994, 37031

35739 (CONF-880752—2) Measuring operator skill and teleoperator performance. Draper, J.V.; Wrisberg, C.A.; Blair, L.M.; Schrock, S.L.; Omori, E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011393/JAW.

From International symposium on teleoperation and control; Bristol, UK (12 Jul 1988).

This paper describes efforts at the Oak Ridge National Laboratory (ORNL) to measure (1) remote handling skill and (2) teleoperator performance. These experimental activities are part of a joint collaboration between the US Department of Energy (USDOE) and the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan in the field of the Nuclear Fuel Cycle: Reprocessing Technology. A valid operator skill test would have many experimental and operational uses, including operator selection and qualification, training program evaluation, assignment of subjects to experimental groups, as a predictor in linear regression or analysis of covariance. ORNL and Japan's PNC have developed a skill test and conducted a validation study. The test predicts performance of a more realistic remote handling task in an ORNL validation study. One flaw in the skill test is that it only uses rate of performance as a skill index. The paper discusses pitfalls of depending on a single criterion and identifies four classes of performance criteria. Performance criteria may assess the rate of performance, the quality of performance, teleoperator impact on the operator, and teleoperator impact on the remote environment. Since there may be trade-offs among the performance domains, using a criterion set which fails to measure all four domains may be misleading or fail to discover important effects.

35740 (DP-MS—88-64-Rev.2) Plutonium scrap recovery at Savannah River: Past, present, and vision of the future. Gray, L.W.; Gray, J.H.; Blancett, A.L.; Lower, M.W.; Rudisill, T.S. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 20p. (CONF-880537—5-Rev.2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010615/JAW.

From 12. actinide separations conference; Naperville, IL, USA (9 May 1988).

As a result of the changing requirement, plus environmental and regulatory commitments, SRP now has essentially completed its paradigm shift. SRP has been transformed from primarily a reprocessor of irradiated uranium targets to primarily a reprocessor of non-specification plutonium. This is the mission which will carry SRP into the 21st Century. Accomplishment of the defined goals for the three-pronged R&D program will achieve several objectives: exploit new processes for recovering low-grade scraps; enhance SRP's position to incorporate pyrochemical processes where they are attractive or beneficial to plant scrap recovery; provide SRL/SRP with a capability to develop compatible aqueous pyrochemical processes; identify material compatibility requirements for the incorporation of pyrochemical processes at SRP; promote development and demonstration of improved NDA instrumentation to accurately measure plutonium holdups in solid residues; identify and implement the technology required for reagent preparation and atmospheric quality control; provide a means to compare economic options for emerging new processes; and as a result, identify process steps which will also put SRP in a position to readily adapt to changing plutonium missions.

35741 (INIS-mf—11194) Development of a simulation program to study error propagation in the reprocessing input accountancy measurements. Sanfilippo, L. (Rome Univ. (Italy)). 1987. 160p. (In Italian). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702373/JAW.

A physical model and a computer program have been developed to simulate all the measurement operations involved with the Isotopic Dilution Analysis technique currently applied in the Volume - Concentration method for the Reprocessing Input Accountancy, together with their errors or uncertainties. The simulator is apt to easily solve a number of problems related to the measurement sctivities of the plant operator and the inspector. The program, written in Fortran 77, is based on a particular Montecarlo technique named "Random Sampling"; a full description of the code is reported.

35742 (KFK—4329) Hydrodynamical models of extraction. Nagel, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Dec 1987. 25p. (In German). (PWA—74/87). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753389/JAW.

The hydrodynamical operation of an extractor has been modelled. The basis of these models are first the subdivision of the extractor into well-mixed discrete stages, and second the diffusion. The calculations need material balances around each phase of a stage, or in a differential slice and the appropriate boundary conditions. The methods for getting time-independent solutions, fundamental differences of the models, as well as dependences of the results on operation parameters have been demonstrated. In the case of the discrete stage model time-dependent calculations have been performed, and the results showed clearly influences of different boundary conditions.

35743 (RFP—4226) Calculated phase diagrams of pyrochemical systems at the Rocky Flats Plant. Murray, A.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1988. Contract AC04-76DP03533. 52p. (CONF-880537—7). NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010898/JAW.

From 12. actinide separations conference; Naperville, IL, USA (9 May 1988).

The phase diagrams can help in understanding the process. The approach taken is calculated binary and ternary phase diagrams and optimized thermodynamic parameters. The salt extraction system uses the salts Cs_2PuCl_6 and $CaCl_2$. Al, Mg, and Ca are used in the salt scrub system. Phase sections are given together with recommendations. (DLC)

0509 Transport And Storage

REFER ALSO TO CITATION(S) 35890, 37279, 37285, 37348

35744 (GAO/RCED—87-123) Nuclear waste: Shipping damaged fuel from Three Mile Island to Idaho. (General Accounting Office, Washington, DC (USA)). 1987. 61p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The March 1979 accident at Three Mile Island produced about 150 tons of highly radioactive debris. The Department of Energy decided to ship the damaged nuclear fuel to Idaho because (1) of its facilities and radiological research expertise; (2) the shipping containers were designed and tested, and independently reviewed by the Nuclear Regulatory Commission to ensure that radioactivity would not escape during any credible accident; and (3) the criteria for route selection was the best quality track, shortest distance, and avoidance of large population centers.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 35737, 35800, 35801, 35802

35745 (PNL-SA—15396) Commercial use of byproduct cesium as an irradiation source. Chin, A.; Fairand, B.P.; Tingey, G.L. (Pacific Northwest Lab., Richland, WA (USA); Radiation Sterilizers, Inc., Menlo Park, CA (USA)). Feb 1988. Contract AC06-76RL01830. 11p. (CONF-880354—7). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008174/JAW.

From Waste management '88; Tucson, AZ, USA (1 Mar 1988).

Byproduct cesuim was recovered from Hanford nuclear waste following removal of the plutonium product and recovery of the enriched uranium from the spent nuclear fuel. The major incentive for recovery of the cesium, along with strontium, was reduction of the heat-generation rate in the waste tanks. Removal of these two heat-producing chemical species results in more than 90% reduction in heat generation in neutralized waste from 1-year-old fuel, and thus, much lower temperatures result in the tanks. The cesium was recovered from the Hanford waste stream beginning in 1967 and was purified and encapsulated from 1974 to 1983, resulting in 1576 capsules containing a total of about 75 MCi of ^{137}Cs. Although these capsules were designed to ease the handling of the waste, they also have substantial potential for use in industrial irradiators. The use of the WESF capsules to meet the demands of the medical industry turned out to be the most viable option, and several companies petitioned the US Department of Energy to obtain this material. To date, two commercial firms are using WESF cesium capsules in three commercial irradiation facilities. A third firm has recently leased a small amount of cesium. A total of 38 MCi in over 700 WESF capsules has been leased. 7 refs., 3 figs.

35746 Uranium mining viability issue in the USA. Clark, G. (USDOE Energy Information Administration, Washington, DC). pp 332-341 of Uranium and nuclear energy: 1986. Proceedings of the 11. international symposium held by the Uranium Institute, London, UK, 2-4 September 1986. London, England; Uranium Institute (1987). (CONF-860915—).

From 11. annual symposium of the Uranium Institute; London, UK (3 Sep 1986).

The viability of the uranium industry in the United States is discussed against the background of past and present government responsibilities in this area and pending legislation. The history of the uranium industry is outlined. Federal responsibilities over the industry are illustrated. Criteria for the viability of the US domestic uranium industry are listed. The three pieces of proposed legislation before the Congress are explained. The first is a resolution disapproving of the proposed enrichment services submitted by the Department of Energy in 1986. The second concerns trade sanctions against South Africa and the third concerns tailings reclamation and restrictions on imported uranium. (U.K.).

0520 Waste Management

REFER ALSO TO CITATION(S) 35873, 35890, 36666, 36941, 36948, 37068, 37563, 37766, 37831, 37832, 37837, 37853, 37854, 37975, 38167, 38168, 38175, 38193

35747 (AERE-G—4393) Glass compositions suitable for PFR wastes. Annual progress report 1985-1986. Boult, K.A.; Dalton, J.T.; Eccles, E.W.; Hough, A.; Marples, J.A.C.; Paige, E.L.; Sutcliffe, P.W. (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Sep 1987. 38p. (DOE-RW—87.095). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753504/JAW.

In previous work, a glass composition (PFR116) had been identified as suitable for vitrifying high level wastes from the Prototype Fast Reactor (PFR) fuel reprocessing plant. Further work has now shown that: (a) it is tolerant of quite large variations in the proportion of waste in the glass: (b) it could also be used to vitrify waste from the European Demonstration Reprocessing Plant. Current wastes from the PFR reprocessing plant contain Cu and Zn which arise from the use of a sacrificial brass basket to transfer chopped fuel to the dissolver. It was originally thought that the presence of the resulting CuO and ZnO in the glass would lead to increased corrosion rates of the Inconel alloys that are used in vitrification plants. Further compatibility tests have shown that this is not so although some Cu contamination of Inconel 690 does seem to occur.

35748 (AERE-R—12597) Initial study of the behaviour under repository conditions of inactive components of nuclear wastes. Biddle, P.; Rees, J.H. (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Feb 1988. 80p. (DOE-RW—88.002). H.M. Stationery Office, London, price Pound 6.00.

This review extends the appreciation of repository behaviour to include the inactive components of wastes and their degradation products. These materials include a wide range of metals and organics, sludges and decommissioning wastes. The effect of degradation products on the solubility of long-lived radionuclides and any active daughters and their sorption on surfaces of the repository are assessed. Research requirements are identified that may help to improve significantly the assessment of the effects of inactive materials. Data required to improve the quality of inventory data on nuclear wastes are listed.

35749 (ANL/EES-TM—344) Assessing waste management systems using reginalt software. Meshkov, N.K.; Camasta, S.F.; Gilbert, T.L. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 32p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008466/JAW.

A method for assessing management systems for low-level radioactive waste is being developed for US Department of Energy. The method is based on benefit-cost-risk analysis. Waste management is broken down into its component steps, which are generation, treatment, packaging, storage, transportation, and disposal. Several different alternatives available for each waste management step are described. A particular waste management system consists of a feasible combination of alternatives for each step. Selecting an optimal waste management system would generally proceed as follows: (1) qualitative considerations are used to narrow down the choice of waste management system alternatives to a manageable number; (2) the costs and risks for each of these system alternatives are evaluated; (3) the number of alternatives is further reduced by eliminating alternatives with similar risks but higher costs, or those with similar costs but higher risks; (4) a trade-off factor between cost and risk is chosen and used to compute the objective function (sum of the cost and risk); and (5) the selection of the optimal waste management system among the remaining alternatives is made by choosing the alternative with the smallest value for the objective function. The authors propose that the REGINALT software system, developed by EG & G Idaho, Inc., as an acid for managers of low-level commerical waste, be augmented for application to the managment of DOE-generated waste. Specific

recommendations for modification of the REGINALT system are made. 51 refs., 3 figs., 2 tabs.

35750 **(ANL/ES—151) Using geologic conditions and multiattribute decision analysis to determine the relative favorability of selected areas for siting a high-level radioactive waste repository.** Harrison, W.; Edgar, D.E.; Baker, C.H.; Buehring, W.A.; Whitfield, R.G.; Van Luik, A.E.J.; Sood, M.K.; Flower, M.F.J.; Warren, M.F.; Jusko, M.J.; Peerenboom, J.P.; Bogner, J.E. (Argonne National Lab., IL (USA)). May 1988. Contract W-31109-ENG-38. 109p. NTIS, PC E08/MF $7.15; 1; GPO Dep. Order Number DE88011219/JAW.

Includes 8 sheets of 48x reduction microfiche.

A method is presented for determining the relative favorability of geologically complex areas for isolating high-level radioactive wastes. In applying the method to the northeastern region of the United States, seismicity and tectonic activity were the screening criteria used to divide the region into three areas of increasing seismotectonic risk. Criteria were then used to subdivide the area of lowest seismotectonic risk into six geologically distinct subareas including characteristics, surface-water and groundwater hydrology, potential human intrusion, site geometry, surface characteristics, and tectonic environment. Decision analysis was then used to identify the subareas most favorable from a geologic standpoint for further investigation, with a view to selecting a site for a repository. Three subareas (parts of northeastern Vermont, northern New Hampshire, and western Maine) were found to be the most favorable, using this method and existing data. However, because this study assessed relative geologic favorability, no conclusions should be drawn concerning the absolute suitability of individual subareas for high-level radioactive waste isolation. 34 refs., 7 figs., 20 tabs.

35751 **(BMI/OCRD—27) Performance evaluations related to area characterization of crystalline rock.** (Golder Associates, Inc., Golden, CO (USA)). May 1988. Contract AC02-83CH10139. 166p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88011535/JAW.

This report discusses the use of performance-based procedures as a planning tool to assist the development and implementation of the Crystalline Rock Repository Project (CRP). Fundamentally, performance assessment is simply a method of expressing our knowledge about a site in a defensible quantitative manner in terms of meaningful performance criteria. Once developed, these procedures can be utilized as tools to assist the CRP in resolving specific program issues. Conceptually, this involves the ability to estimate site performance based on current information and, by postulating the effect of new information, estimate the changes in performance estimates as a result of future program decisions. This provides a means of examining the probable outcome of alternative program decisions without actually carrying out these decisions. The probable results of different program decision paths can then be compared to determine the optimum choice based on current information. The performance-based procedures rely on the implementation of a general performance assessment system to predict site performance. This system or framework must be at least partially in place in order to implement any of the performance-based procedures. Essentially this would involve identification of program requirements, analysis of processes and characteristics that determine compliance with requirements, development of a procedure to assess site characterization and uncertainties, and development of models to estimate performance. Although the framework needs to be defensible and repeatable, it need not include complex and sophisticated models. Rather, the models and procedures should be consistent with the level of available information at any stage in the program. 65 refs., 54 figs., 12 tabs.

35752 **(BMI/ONWI/C—50) Salt Repository Project closeout task report on repository simulation modeling: April 27, 1988.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 27 Apr 1988. Contract AC02-87CH10290. 465p. NTIS, PC A20;3. Order Number DE88011647/JAW.

This report documents the work of the Salt Repository Project in the area of repository simulation modeling at the time of Project termination. It briefly describes the Project's simulation modeling and includes various published and unpublished simulation modeling reports, as appendices. It is important to note that, because of Project termination, some of the material provided in this report has not been subjected to detailed technical review as normally given to published technical documents.

35753 **(BMU—1986-142) Activities of the OECD/NEA, EC and IAEA in the field of radioactive waste treatment.** Mester, W. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1986. 188p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Whereas the EC and NEA tend to focus on scientific issues in their member states (research and development), the IAEA objectives are orientated more to the needs of the developing countries, i.e. information exchange and development of directly applicable rules and guidelines. The following chapters summarize the tasks and targets of NEA, EC and IAEA in the field of waste treatment and final storage, their major areas of interest, associated working parties and, in as much as possible, future trends. In addition, the German representatives in the various committees and working groups are listed.

35754 **(BMU—1987-155) Investigations on the comparison of toxicity of radioactive wastes with elements in a mine deposit and in filter dust.** Biesold, H.; Haider, G. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1987. 27p. (In German). (GRS-A—1309). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

For an estimate of the potential danger of a final store for radioactive waste, comparisons with ores containing heavy metals and with filter dust from coal-fired power stations were made based on hazard measurement for radioactive and chemically toxic materials. The results show that the radioactive toxicity of a finally stored fuel element 10^9 years after storage and that of high activity waste several times 10^7 years after final storage is higher than the chemical toxicity of elements which occur in minerals forming sulphide ores. The concentrations and the derived hazard measurements for chemically toxic elements in electrical filter dust are 1-3 orders of magnitude less for the elements examined here than those of ore deposits and are lower in the course of time. Taking into account the filling factor for radioactive waste, as is usual in borehole technique, then the times are reduced to 10^5 and 10^4 years respectively.

35755 **(BMU—1987-157) Investigation of the behaviour of a pillar under rock load and at geothermal temperature with the STEALTH computer program.** Mohiuddin, G. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jan 1987. 73p. (In German). (GRS-A—1331). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

In this calculation, the behaviour of open hollow spaces in a saltmine (730 m underground) under rock load and at geothermal temperature was examined and a pillar was selected for this. There is a section with a rounded cross section of different size (15 m^2 and 25 m^2) on each side of the pillar. It was assumed that the section is immediately present to the full extent at time t=0; the time effect of section break-out was neglected. The support pressure, i.e. the internal pressure in the section is 10^5 Pa and the geothermal temperature is 37°C. The simulation was done in two different ways. In the first case, the internal pressure was modelled by the so-called pressure boundary conditions, while in the second case,

the section was represented by air-filled mesh. Both calculations showed similar convergence rates. The convergence rates depend on the size of the cross section and on the shape of the section cross section. The convergence rates of the greater section is less than that of the smaller section. The rounded shape of the sections is favourable as regards stress compared with the rectangular section, as no tensile stresses occur in the pillar at any time; there is always security against fracture.

35756 **(BNL-NUREG—40914) The effect of cure conditions on the stability of cement waste forms after immersion in water.** Siskind, B.; Adams, J.W.; Clinton, J.H.; Piciulo, P.L.; McDaniel, K. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1988. Contract AC02-76CH00016. 11p. (CONF-880201—35). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007970/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

We investigated the effects of curing conditions on the stability of cement-solidified ion-exchange resins after immersion in water. The test specimens consisted of partially depleted mixed-bed bead resins solidified in one of three vendor-supplied Portland I cement formulations, in a reference cement formulation, or in a gypsum-based binder formulation. We cured samples prepared using each formulation in sealed containers for periods of 7, 14, or 28 days as well as in air or with an accelerated heat cure prior to 90-day immersion in water. Two cement formulations exhibited apparent Portland-cement-like behavior, i.e., compressive strength increased or stabilized with increasing cure time. Two cement formulations exhibited behavior apparently unlike that of Portland cement, i.e., compressive strength decreased with increasing cure time. Such non-Portland-cement-like behavior is correlated with higher waste loadings. The gypsum-based formulation exhibited approximately constant compressive strength with cure time. Accelerated heat cures may not give compressive strengths representative of real-time cures. Some physical deterioration (cracking, spalling) of the waste form occurs during immersion.

35757 **(BNL-NUREG—40927) Characterization of low-level waste from the industrial sector, and near-term projection of waste volumes and types.** MacKenzie, D.R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 11p. (CONF-880201—36). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007969/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

A telephone survey of low-level waste generators has been carried out in order to make useful estimates of the volume and nature of the waste which the generators will be shipping for disposal when the compacts and states begin operating new disposal facilities. Emphasis of the survey was on the industrial sector, since there has been little information available on characteristics of industrial LLW. Ten large industrial generators shipping to Richland, ten shipping to Barnwell, and two whose wastes had previously been characterized by BNL were contacted. The waste volume shipped by these generators accounted for about two-thirds to three-quarters of the total industrial volume. Results are given in terms of the categories of LLW represented and of the chemical characteristics of the different wastes. Estimates by the respondents of their near-term waste volume projections are presented.

35758 **(CEA-DAS—435) α and long-lived $\beta\gamma$ waste source term. A first generation model for a deep cemented waste repository.** Lovera, P.; Mangin, J.P.; Jorda, M.; Lewi, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). 1987. 12p. (CONF-8711194—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753473/JAW.

From NEA seminar on evaluation of source term modelling for waste storage; Baden, Switzerland (23 Nov 1987).

According to the normal scenario of radioactivity release to the biosphere, only long-lived nuclides are able to migrate significantly to the surface. A first generation model, concerning a cemented waste of hulls and ends deeply disposed of in a granitic medium is in progress at CEA. Two nuclides have been selected: 237-Neptunium (as a reference of α emitters) and 135-Cesium (as a reference of long-lived β emitters). Attributing the long term activity to these both nuclides leads to a model which is conservative beyond ca. 150000 years. Principal difficulties arise from physico-chemical behaviour of Neptunium in aqueous phase, and from non-linear Cesium adsorption on various media. Condiment code (versions 2 and 3), which is developed parallely to the present model is conceived to take account for these phenomena.

35759 **(CONF-871102—3) Applications of a standard leaching test for waste forms.** Godbee, H.W.; Anders, O.U. (Oak Ridge National Lab., TN (USA); Dow Chemical U.S.A., Midland, MI). 1987. Contract AC05-84OR21400. 7p. (CONF-871102—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008665/JAW.

From International waste management conference; Kowloon, China (29 Nov 1987).

The American National Standard, "Measurement of the Leachability of Solidified Low-Level Radioactive Wastes by a Short-Term Procedure," ANSI/ANS-16.1-1986, provides a uniform procedure to measure and index the release of nuclides from waste forms as a result of leaching. It provides a mathematical procedure for calculating a "Leachability Index" value from the test data. The merits and demerits of the procedure, based on several years of usage, are discussed. The results obtained for waste forms by this procedure are compared with the results obtained on specimens of the same waste form using the MCC-1 test protocol of the Materials Characterization Center of the US Department of Energy. 5 refs., 1 fig., 2 tabs.

35760 **(CONF-880377—3) Analysis of corrosion data for carbon steels in simulated salt repository brines and acid chloride solutions at high temperatures.** Diercks, D.R.; Hull, A.B.; Kassner, T.F. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31-109-ENG-38. 27p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88012030/JAW.

From Joint U.S. DOE/FRG workshop on nuclear package materials; Albuquerque, NM, USA (9 Mar 1988).

Carbon steel is currently the leading candidate material for fabrication of a container for isolation of high level nuclear waste in a salt repository. Since brine entrapped in the bedded salt can migrate to the container by several transport processes, corrosion is an important consideration in the long-term performance of the waste package. A detailed literature search was performed to compile relevant corrosion data for carbon steels in anoxic acid chloride solutions, and simulated salt repository brines at temperatures between ~ 20 and 400°C. The hydrolysis of Mg^{2+} ions in simulated repository brines containing high magnesium concentrations causes acidification at temperatures above 25°C, which, in turn, influences the protective nature of the magnetite corrosion product layer on carbon steel. The corrosion data for the steels were analyzed, and an analytical model for general corrosion was developed to calculate the amount of penetration (i.e., wall thinning) as a function of time, temperature, and the pressure of corrosion product hydrogen than can build up during exposure in a closed system (e.g., a sealed capsule). Both the temperature and pressure dependence of the corrosion rate of steels in anoxic acid chloride solutions indicate that the rate-controlling partial reaction is the cathodic reduction of water to form hydrogen. Variations in the composition and microstructure of the steels or the concentration of the ionic species in the chloride solutions (provided that they do not change the pH significantly) do not appear to strongly influence the corrosion rate.

35761 **(CONF-880601—30) Assessment of seismic hazards at Yucca Mountain.** King, J.L.; Frazier, G.A.; Grant, T.A. (Science Applications International Corp., Las Vegas, NV (USA)). 1988. Contract AC08-87NV10576. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009010/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

During the preclosure time period (approximately 100 yr), the prospective geologic repository at Yucca Mountain must provide for public and worker radiological safety and retrievability of emplaced waste. During the postclosure period (10,000 yr), the re-

pository must ensure that cumulative radionulclide releases to the accessible environment comply with EPA release limits. Substantially complete containment must be provided by the waste packages for 300-1000 yr. All of these functions must be maintained should a severe seismic event occur and must be achieved with reasonably available technology. The seismic phenomena of interest for the preclosure period are vibratory ground motion from a nearby earthquake or underground nuclear explosion (UNE), faulting beneath surface facilities that are important to safety, and faulting in underground areas of emplaced waste. For the postclosure period, earthquake ground motion, underground faulting, and seismically induced adverse changes in hydrologic conditions have been identified as the most important seismic phenomena to be characterized. The NNWSI Project Site Charcterization Plan describes a number of seismic parameters that are needed for repository design or performance assessment, along with tentative goals for each parameter. Key parameters, goals and current assessments, all subject to change as site characterization progresses, are summarized in this report. 4 refs.

35762 (CONF-880652—1) Hydrogeologic characterization activities on the Oak Ridge Reservation, Tennessee, in support of waste management studies in a humid environment. Stow, S.H.; Huff, D.D.; Haase, C.S.; Ketelle, R.H. (Oak Ridge National Lab., TN (USA); Jordan (E.C.) Co., Oak Ridge, TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011006/JAW.

From International symposium on hydrogeology and safety of radioactive and industrial hazardous waste disposal; Orleans, France (7 Jun 1988).

Extensive geohydrologic characterization work is under way on the Oak Ridge Reservation in East Tennessee. This site is extremely complex geologically and hydrologically and lies in an area of significant rainfall. Recent regulatory requirements pertaining to protection of groundwater and to the management of radioactive and hazardous wastes, which have been disposed of on the Reservation for 45 years, are the primary reason for this extensive characterization. 4 refs., 3 figs.

35763 (CONF-880741—3) Low-level radioactive waste disposal at a humid site. Lee, D.W. (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007478/JAW.

From Joint CSCE-ASCE conference on environmental engineering; Vancouver, Canada (13 Jul 1988).

Waste management in humid environments poses a continuing challenge because of the potential contamination of groundwater in the long term. Short-term needs for waste disposal, regulatory uncertainty, and unique site and waste characteristics have led to the development of a site-specific waste classification and management system proposed for the Oak Ridge Reservation. The overlying principle of protection of public health and safety is used to define waste classes compatible with generated waste types, disposal sites and technologies, and treatment technologies. 1 fig., 1 tab.

35764 (CONF-8806148—1) Characterization of solid low-level radioactive waste at the Oak Ridge National Laboratory. Van Cleve, J.E. Jr. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011383/JAW.

From French National Waste Management Agency (ANDRA) meeting; Paris, France (6 Jun 1988).

This paper describes the current methods used to characterize solid low-level radioactive waste at the Oak Ridge National Laboratory. Two systems are described: one based on the isotopic content of the waste and the second on the radiation exposure rate at the waste package surface. The latter system was implemented in mid-1986 as a result of greater emphasis on limiting personnel radiation exposure.

35765 (DOE/EA—0078) Environmental impact assessment of the former airport storage site of the Atomic Energy Commission, St. Louis County, Missouri. (Oak Ridge National Lab., TN (USA)). Jul 1979. Contract AC05-84OR21400. 161p. NTIS, PC A08;3. Order Number DE88008857/JAW.

The primary purpose of this Environmental Assessment is to evaluate the adequacy of the Quit-Claim Deed, used to protect public health, safety and environmental quality. The assessment evaluates two proposed actions: (1) the use of this deed to control present radiation exposure from the site, and (2) the use of the deed to control anticipated radiation exposure from the site after the burial of approximately 18,300 to 50,000 yd^3 of contaminated material from a former AECNRC licensed site (the Latty Avenue site) located about 34 mile northeast of the airport storage site. Four alternatives to the proposed actions are also evaluated: (1) complete site decontamination with removal of radioactive material to an unidentified location; (2) release of the site for {open←quotes}unrestricted use{close←quotes} with no further action; (3) release of the site for {open←quotes}unrestricted use{close←quotes} after burial of contaminated material from the Latty Avenue site; and (4) continued restriction of the site with no development of the site permitted.

35766 (DOE/HWP—40) A review of state regulations that exceed those of the federal Resource Conservation and Recovery Act (RCRA). Coutant, C.C.; Heckman, C.L. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 187p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88010750/JAW.

This report identifies and provides information on state hazardous waste management programs and regulations in states where the US Department of Energy (DOE) has facilities. The objective is to describe for the DOE defense program and its contractors how state requirements are more stringent than the federal regulations under the Resource Conservation and Recovery Act (RCRA). DOE defense programs are located in 13 of the 50 states. Most of these states have regulations that are essentially equivalent to the federal RCRA requirements as they existed prior to the 1984 amendments, but their regulations are, in most instances, more stringment than the federal requirements. Differences are both substantive and procedural, and they are summarized and tabulated herein. All but three of these 13 states have been granted Final Authorization from the US Environmental Protection Agency (EPA) to operate their own hazardous waste management program in accord with the federal RCRA program prior to the 1984 amendments; two of the three others have some stage of Interim Authorization. EPA currently administers all of the provisions of the 1984 amendments, including requirements for corrective action under Sect. 3004(u). Two states, Colorado and Tennessee, have been granted revisions to their Final Authorizations delegating responsibility for the hazardous wastes. Responsible state agencies (with appropriate telephone numbers) are indicated, as are the relevant laws and current regulatory statutes.

35767 (DOE/ID/12476—T3) Assessment of the requirements for DOE's annual report to congress on low-level radioactive waste. (Inter/Face Associates (USA)). Oct 1987. Contract FG07-83ID12476. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011143/JAW.

The Low-level Radioactive Waste Policy Amendments Act of 1985 (PL99-240; LLRWPAA) requires the Department of Energy (DOE) to "submit to Congress on an annual basis a report which: (1) summarizes the progress of low-level waste disposal siting and licensing activities within each compact region, (2) reviews the available volume reduction technologies, their applications, effectiveness, and costs on a per unit volume basis, (3) reviews interim storage facility requirements, costs, and usage, (4) summarizes transportation requirements for such wastes on an inter- and intra-regional basis, (5) summarizes the data on the total amount of low-level waste shipped for disposal on a yearly basis, the proportion of such wastes subjected to volume reduction, the average volume reduction attained,, and the proportion of wastes stored on an interim basis, and (6) projects the interim storage and final disposal volume requirements anticipated for the following year, on a regional basis (Sec. 7(b))." This report reviews and as-

sesses what is required for development of the annual report specified in the LLRWPAA. This report addresses each of the subject areas set out in the LLRWPAA.

35768 **(DOE/ID/12576—T5) Plans for dealing with loss of access to the Midwest compact regional disposal facility: Regional management plan.** Sutherland, A.A. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). 28 Jul 1986. Contract FG07-85ID12576. 37p. (RAE—8503/3-2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008158/JAW.

A sudden and unexpected cessation of operations at the Midwest Compact's regional disposal facility could have dire consequences for the hospitals, universities and industries that generate low-level waste. To avoid interrupting important activities at these institutions, the Compact Commission must review alternatives available for managing low-level waste should the Midwest disposal facility become unavailable. Section 2 describes events that could lead to the premature closure of a disposal facility and the prospects that the closed facility could eventually be reopened. Section 3 discusses possible courses of action leading to disposal outside the Midwest region while the Midwest Compact works to reestablish a regional disposal capability. Section 4 presents a likely division of responsibilities between the Compact Commission and the individual member states, with emphasis on managing low-level waste after a loss of access when disposal outside the Midwest is not possible. Section 5 describes key elements in an agreement between compacts to accept each other's waste when one compact has experienced an unexpected interruption of its disposal operation. Section 6 summarizes key points of the report. 4 refs.

35769 **(DOE/ID/12576—T10) Host state incentives and compensation:.** Schneider, P. (ERM-McGlennon Associates, Boston, MA (USA)). 30 Jun 1986. Contract FG07-85ID12576. 37p. NTIS, PC A03;3. Order Number DE88008152/JAW.

After reviewing several options for selecting a host state, the Commission elected to proceed with anoption that builds upon developing grass-roots acceptance and support. To foster such support the Commission has adopted an incentives and compensation package. The purpose of the package is thnt the incentives and compensations offered are designed to encourage an objective and unbiased review of accepting the responsibilities of a host state or community, and the package helps to guarantee that a facility will become a state/community asset and not impose economic, environmenta, or social hardships for the host community. This report, which describes the Commission's host state incentive and compensation package, the monetary benefit to the host community and state will be substantial. Community benefits will exceed $40 million over 20 years and benefits to the state will be approximately $24 million over the 20-year expected life of the facility. 10 refs., 4 tabs.

35770 **(DOE/ID/12584—24) Environmental monitoring report on the US Department of Energy's Grand Junction Projects Office facility, Grand Junction, Colorado, for calendar year 1987.** (UNC Geotech, Grand Junction, CO (USA)). May 1988. Contract AC07-86ID12584. 4p. (UNC/GJ-HMWP—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011469/JAW.

This report presents results of environmental monitoring activities conducted in 1987 at the US Department of Energy's (DOE) Grand Junction Projects Office (GJPO) Facility in Colorado. The site is included under the DOE's Defense Decontamination and Decommissioning (Defense D & D) Program.

35771 **(DOE/ID/12640—T1) Operational experience with selective ion-exchange media in sluiceable pressurized demineralizers at nuclear power plants: Final draft.** (Analytical Resources, Inc., Wyomissing, PA (USA)). 6 May 1987. Contract FG07-86ID12640. 46p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number TI88008554/JAW.

DURASIL selective ion-exchange media has been successfully used in processing liquid radioactive waste at several nuclear power plants. Processing at three (3) of these plants indicates that when selective ion-exchange DURASIL media replace non-selective organic ion-exchange resins, greater throughputs, substantial radwaste volume reduction, personnel exposure reduction, operator man-hour reductions, reduced effluent releases, and higher processing decontamination factors (DF) can be expected. Very little data was available on operator related matters (e.g., operator requirements, radiation exposure, etc.) or on the economics of the system. However it is known that DURASIL media has an average cost that is about 7-8 times that of organic ion exchange resins. Despite the lack of detailed cost data, there is an overall economic advantage with DURASIL media over organic resins: Effective ion exchange capacity is 5-10 times greater; only radioactive ion species are captured while other non-radioactive ions pass through; the DF for typical radioactive species is 5-15 times higher; and the process rate is 2-5 times faster. Power plants which are processing liquid waste streams with Duratek's products indicate that they are experiencing: Higher volumetric throughputs; increased liquid processing flowrates; reduced radioactivity DFs; reduced radioactive waste volumes required disposal; reduced operator time; and lower personal radiation exposure. 8 figs., 16 tabs.

35772 **(DOE/NE/44352—T3) Massachusetts' participation in the US Department of Energy's Crystalline Repository Project: Final report.** Dukakis, M.S.; Johnston, P.W.; Walker, B. Jr. (Massachusetts Dept. of Public Health, Boston (USA)). Dec 1986. Contract FG02-83NE44352. 180p. NTIS, PC A09;3. Order Number DE88008003/JAW.

The purpose of this report is to review activities of the Crystalline Rock Project (CRP) in Massachusetts, the context in which it arose, and the implications and possibilities of future federal policy decisions on the siting of a HLW repository in a crystalline rock body. Although Massachusetts has been eliminated from consideration, there are still issues of concern to be resolved regarding the potential impacts upon Massachusetts if a site were ever to be chosen in New England.

35773 **(DOE/OR/00033—T401) Managing the uncertainty in the radiological assessment component of repository performance assessment.** Massey, C.D. (Oak Ridge Associated Universities, Inc., TN (USA); Pittsburgh Univ., PA (USA)). 1988. Contract AC05-76OR00033. 232p. University of Pittsburgh, 4200 Fifth Avenue, Pittsburgh, PA 15260. Order Number TI88008617/JAW.

The purpose of this study was to develop an approach for performing sensitivity and uncertainty analyses; to develop an efficient method for determining research effort focus; and to provide a framework for approaching analyses of complex environmental assessment models. The approach developed for managing the uncertainty in repository performance assessments was called the M- and U-Significance Approach (MUSA). MUSA was developed as part of this study using a generic radiological assessment code named MUST. The MUST code was developed using mathematical equations used by the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA). MUST was verified using results generated by the EPA for use in setting EPA's high-level radioactive waste standards. Since MUST is a probabilistic code, a comparison of its predictions with the predictions of the EPA's deterministic code was used to illustrate the usefulness of probabilistic assessments and demonstrates the process of showing reasonable compliance with regulatory standards. 359 refs., 19 figs., 5 tabs.

35774 **(DOE/RL/11388—T1) Bureau of Mines review of Department of Energy report {open←quotes}Exploratory shaft design basis study review{close←quotes}: Final technical report.** (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). [1987]. Contract AI06-87RL11388. 35p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011608/JAW.

The Basalt Waste Isolation Project (BWIP) is an investigative program being conducted by the US Department of Energy to determine the feasibility of locating a nuclear waste repository in the deep basalts beneath the Hanford Site in south-central Washington. As part of the site characterization phase of the program, an Exploratory Shaft Facility (ESF) will be constructed to conduct in situ testing for site characterization and feasibility. The Bureau of

Mines has been solicited by DOE, through an Interagency Agreement, to review the subject report as an independent reviewer. The review of this report covers three general areas: hydrology, ventilation, and shaft sinking and excavation. The hydrology section evaluates water inflow parameters and quantities and the water inflow range. The ventilation section evaluates underground ventilation air quantities; methane inflow parameters and quantities; gassy mine cost impacts; shaft ventilation and conveyance velocity criteria; and methane release rate. The shaft sinking and excavation section evaluates the second shaft cost estimate and hoisting; underground development schedule; and underground drifting. 8 refs.

35775 **(DOE-RW—87.108) Release mechanisms from shallow engineered trenches used as repositories for radioactive wastes.** Locke, J.; Wood, E. (National Nuclear Corp. Ltd., London (UK)). (Department of the Environment, London (UK); National Nuclear Corp. Ltd., London (UK)). May 1987. 94p. (NNC—1096). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753985/JAW.

This report has been written for the Department of the Environment as part of their radioactive waste management research programme. The aim has been to identify release mechanisms of radioactivity from fully engineered trenches of the LAND 2 type and, to identify the data needed for their assessment. No direct experimental work has been involved. The report starts with a brief background to UK strategy and outlines a basic disposal system. It gives reviews of existing experience of low level radioactive waste disposal from LAND 1 trenches and of UK experience of toxic waste disposal to provide a practical basis for the next section which covers the implications of identified release mechanisms on the design requirements for an engineered trench. From these design requirements and their interaction with potential site conditions (both saturated and unsaturated zone sites are considered) an assessment of radionuclide release mechanism is made.

35776 **(DOE-RW—88.001) Origin, composition and distribution of 'hot particles' derived from the nuclear industry and dispersed in the environment.** Hamilton, E.I.; Clifton, R.J. (Department of the Environment, London (UK)). Oct 1987. 109p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753511/JAW.

Today, recent sediments of the Esk estuary, Cumbria, contain few hot particles derived from BNF compared with those deposited during peak releases of 1972-1974. Overall the hot particles account for about 10% of the total alpha particle activity of the sediments. At some horizons, in buried sediments, concentrations of hot particles probably represent rapid transport on the sea surface under conditions of minimum erosion. Similar particles, usually less well defined, occur in accreting sediments but are corroded. Representative types of the most radioactive particles have been isolated and contain Pu, Am and Cm but only trace amounts of naturally occuring alpha emitters. Microprobe analysis of these particles often shows the presence of fairly pure uranium as the major element. On the basis of radioactivity and elemental composition many of these particles appear to be irradiated nuclear fuel debris.

35777 **(DOE-RW—88.020) Immobilization of radioactive waste in cement based matrices.** Glasser, F.P.; Macphee, D.; Atkins, M.; Beckley, N.; Carson, S.; McHugh, G.; Mattingley, N.J.; Naish, C.C.; Wilding, C.R. (Department of the Environment, London (UK)). 1988. 106p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753608/JAW.

The modelling of cement behaviour at longer ages is reported. Factors studied include composition, pH and Esub(h). The stresses arising from irradiation are evaluated. The behaviour of two elements in cement - U and I has been studied; new experimental data are reported including solubility measurements. Some additional data are given on Sr. Results of desk studies relevant to lifetime predictions are presented.

35778 **(DOE-RW—88.023) Flammable gas production in Land 2 and Land 3/4 radioactive waste repositories.** (Department of the Environment, London (UK)). Feb 1988. 110p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753513/JAW.

Geological, radiolytic and microbiological sources of gas are considered in relation to Land 2 and Land 3/4 type radioactive waste repositories. Geological sources are potentially the most troublesome and it is concluded that site investigation work should be designed to detect gas trap structures, reservoir lithologies or source rocks. Known source and reservoir lithologies should not be considered as suitable for the siting of waste repositories. Radiolytic and microbiological sources will depend on waste characteristics. A detailed review of the literature on radiolytic gas generation is presented and conclusions from this work indicate that water in waste and matrix should be kept to a minimum. Similarly, the level of radioactivity stored in each waste container should be kept to the minimum compatible with the storage design. Microbiological gas sources will be reduced by maintaining the cellulose content of the waste at a minimum. It is suggested that the removal of organics from the waste stream would be beneficial in terms of potential gas production.

35779 **(DOE-RW—88.047) Sensitivity studies on TIME2 Version 1.0.** (Department of the Environment, London (UK); Dames and Moore, London (UK)). Mar 1988. 39p. (DM-TR—11). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753989/JAW.

The results of a sensitivity analysis of Version 1.0 of the TIME2 computer code to certain aspects of the input data set are presented. Parameters evaluated were: river dimensions, the density and grain size of sediment carried by the river, human intrusion data, sea level rise rate, erosion factors and meander modelling data. The sensitivity of the code to variation of single value parameters was evaluated by means of graphical comparisons. For parameters specified as probability density functions (pdf's), the Kolmogorov-Smirnov test was used. The study assists in the specification of data for TIME2 by identifying parameters to which the models used are particularly sensitive and also suggests that some input currently specified as pdf's could be replaced with single values without affecting the quality of the results obtained.

35780 **(DOE/RW—0160-Vol.3) Site characterization plan: Yucca Mountain site, Nevada research and development area, Nevada: Consultation draft, Nuclear Waste Policy Act.** (Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management). Jan 1988. Contract AC08-87NV10576. 638p. H. Order Number TI88007744/JAW.

Chapter six describes the basis for facility design, the completed facility conceptual design, the completed analytical work relating to the resolution of design issues, and future design-related work. The basis for design and the conceptual design information presented in this chapter meet the requiremenrs of the Nuclear Waste Policy Act of 1982, for a conceptual repository design that takes into account site-specific requirements. This information is presented to permit a critical evaluation of planned site characterization activities. Chapter seven describes waste package components, emplacement environment, design, and status of research and development that support the Nevada Nuclear Waste Storage Investigation (NNWSI) Project. The site characterization plan (SCP) discussion of waste package components is contained entirely within this chapter. The discussion of emplacement environment in this chapter is limited to considerations of the environment that influence, or which may influence, if perturbed, the waste packages and their performance (particularly hydrogeology, geochemistry, and borehole stability). The basis for conceptual waste package design as well as a description of the design is included in this chapter. The complete design will be reported in the advanced conceptual design (ACD) report and is not duplicated in the SCP. 367 refs., 173 figs., 68 tabs.

35781 **(DP—86-125-1/2) Waste management program: Technical progress report, January-June 1986.** (BE, Inc., Barnwell, SC (USA)). Mar 1988. Contract AC09-76SR00001. 24p. (BEI/SRL—8655-1/86). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010335/JAW.

This report provides information on operations and development programs relating to the management of radioactive wastes at the Savannah River Plant. Information on environmental and safety

assessments, waste form development, and process and equipment development are reported for long-term waste management.

35782 **(DP-MS—87-118) Metal toxicity evaluation of Savannah River Plant saltstone comparison of EP and TCLP test results.** Langton, C.A. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 12p. (CONF-880201—37). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008213/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

Saltstone is the waste treatment and disposal concept for low-level defense waste at the Savannah River Plant. The waste is a sodium salt solution which has about 230 μCiL in addition to the hazardous characteristics of corrosivity and metal toxicity (Cr^{+6} > 100 ppM). Two EPA test procedures are routinely used at SRP to evaluate metal toxicity of wastes and wasteforms. 1) the Extraction Procedure (EP); and 2) the Toxicity Characterization Leaching Procedure (TCLP). The EP test is required by SCDHEC and EPA. The TCLP is used to evaluate the effect of increased surface area on metal leaching from the various SRP wasteforms. EP and TCLP test results are presented for two types of wasteforms, a cement-based saltstone and for a slag-based saltstone. The slag saltstone chemically stabilizes and also physically entraps the chromium. For waste solutions with low to intermediate metal concentrations (up to 5000 ppM), the TCLP extracts typically have lower metal values than the EP extracts. This is attributed to the faster neutralization of the acetic acid by the crushed TCLP sample. Crushing increases surface area and consequently releases more alkalinity from the wasteform matrix and the wasteform pore solution. Metal concentrations in the EP and TCLP extracts are proportional to the concentrations of metals in the pore solution for both the cement or slag-based wasteforms. The pore solution concentrations for cement wasteforms are directly related to the soluble metal concentration in the waste. The metal concentration in the slag wasteform pore solutions are significantly lower than the waste because these metals are reduced lower valences and precipitated as insoluble solid phases. 3 refs., 3 figs., 5 tabs.

35783 **(DP-MS—87-153) Immobilization of incinerator ash in a concrete matrix.** Simpson, R.S.; Charlesworth, D.L. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 12p. (CONF-880526—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008217/JAW.

From International conference on incineration of hazardous and radioactive waste; San Francisco, CA, USA (3 May 1988).

The ashcrete process will solidfy ash generated by the consolidated Incinerator Facility (CIF) at the Savannah River Plant (SRP). The ashcrete unit produces ashcrete, a stable cement-based wasteform, by remotely adding cement and water and tumbling drums of ash. Ashcrete product homogeneity, temperature rise during setting, and compressive strength were measured and product formulations were developed for several nonradioactive dry ash types. Saturation level and wet and dry ash densities for several ash types have been measured. Preliminary mixture formulations for the anticipated ash were tested. A proof-of-principle test was performed using a mockup of the CIF ash system. Finally, mechanical modifications to prepare the unit for use with the CIF and to ensure reliable operation are being implemented. 4 refs., 5 figs., 5 tabs.

35784 **(DP-MS—88-76) DWPF [Defense Waste Processing Facility] glass composition control based on glass properties.** Carter, J.T.; Brown, K.G.; Bickford, D.F. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 9p. (CONF-8806111—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010894/JAW.

From Conference on the advances in fusion of glass; Alfred, NY, USA (14 Jun 1988).

The Defense Waste Processing Facility (DWPF) will immobilize Savannah River Plant (SRP) High Level Waste as a durable borosilicate glass for permanent disposal in a civilian repository. The DWPF will be controlled based on glass composition. The waste glass physical and chemical properties, such as viscosity, liquidus temperature, and durability are functions of glass chemistry. Preliminary models have been developed to evaluate the effects of feed composition variability on the glass properties. These properties are presently being related to the waste glass composition in order to develop process control paradigms that include batching algorithms, hold points, and transfer limits. 3 refs., 6 tabs.

35785 **(DP-MS—88-79) Advances in processing nuclear waste glasses.** Plodinec, M.J. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 12p. (CONF-8806111—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011209/JAW.

From Conference on the advances in fusion of glass; Alfred, NY, USA (14 Jun 1988).

The vitrification of nuclear waste glasses is presenting unique challenges to glass technologists. On the one hand, the composition of the most important constituent of the glass batch{–}the waste{–}may vary widely. On the other hand, the vitrification process itself must be tightly controlled to ensure product quality, public safety, and process reliability. This has led to several important developments in waste vitrification technology, all aimed at improving process control. These include use of process models, use of artificial intelligence techniques, and improved control and measurement of glass redox. 19 refs., 2 figs., 2 tabs.

35786 **(DPST—86-219) Experimental canister frit blaster : Final report.** Ward, C.R. (Savannah River Lab., Aiken, SC (USA). Technical Div.). 9 Jan 1986. Contract AC09-76SR00001. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011270/JAW.

The testing program for the Experimental Canister Frit Blaster (ECFB) has been sucessful in meeting all of the major objectives. Testing of the ECFB has demonstrated that the basic design concepts were valid; frit suspension in the blasting chamber sump by recirculation; blasting by canister manipulation in front of stationary nozzles; grapple operation in an abrasive frit environment. Many design improvements were identified during the testing. These improvements were incorporated in the design of the DWPF Canister Decontamination Chamber (CDC), avoiding costly and time consuming modifications to the CDC after fabrication. The required process parameters to adequately clean all areas of the canister with a minimum amount of frit and water were determined. Testing with full scale equipment has allowed required consumption of frit and water to be significantly reduced from the previous assumptions. The optimum sequence of operation for slurry blasting, rinsing and drying the canister was determined. The sequence of operation developed for the CDC is very complex and has 104 steps. Developing the sequence of operation for the CDC would have been extremely difficult without the experience gained from the operation of the ECFB. The ECFB testing program has been completed and the ECFB has been shutdown. 4 refs., 14 figs., 6 tabs.

35787 **(DPST—86-714) Sampling strategy for the DWPF.** Postles, R.L. (Savannah River Lab., Aiken, SC (USA)). 9 Oct 1986. Contract AC09-76SR00001. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009572/JAW.

Since both upstream (feed & process) and downstream (product sampling & assay) indicators are informative, some combiantion of the two will be more informative than either alone (if both are accurate). A "Kalman Filter" is a "Bayesian" combination of the two which seems to me particularly appropriate for your purposes. The Kalman Filter estimate of the leach-rate would be a linear combination of your upstream projection "P" and the pertinent downstream in-canister measurement "M" (if there is one for that canister). The projection would be "up-dated" by the measurement to an extent determined by their difference and the relative uncertainties in each; viz: [Kalman Estimate] = P + K(M-P) $0 \leq K \leq 1$. The two extremes which bound options are: to project only (K=O), or to measure only (K=1). An intermediate position, a value K{ne}O,1 commensurate with the relative merits of upstream projection vis-a-vis the essential difficulty of characterizing the in-canister waste product, should be your goal. A promising position may be to project upstream knowledge "strongly" while yet relying on some product sampling for verification.

35788 **(DPST—88-386) FB-Line shredding tests.** Meyer, M.I. (Savannah River Lab., Aiken, SC (USA)). 12 Apr 1988. Contract AC09-76SR00001. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011269/JAW.

In support of the planned upgrade of FB-Line, IWTD performed shredding tests on 10 different potential waste materials that can be found in the gloveboxes. Over 200 pounds of material were shredded in approximately 16 hours. Bulk densities of the material ranged from 1.6 to 66 lbft^3; chemwipes and HOMALITE support rings were the lower and upper density materials, respectively. Shredding times ranged from 0.2 to 5.7 minutes with polyvinylchloride bags taking the longest shred time. A maximum volume reduction ratio of 6.9:1 was attained upon shredding HOMALITE glove support rings. Polypropylene spun filters and polyethylene bottles expanded upon shredding with a volume increase of 70 and 40 percent, respectively. Absorbancy tests indicated a single chemwipe can absorb 5.5 and upon squeezing, retain 2.5 times its weight in water. 2 tabs.

35789 **(DPST—88-494) SRL in-situ tests in the United Kingdom: Part 1, program document and sample emplacements.** Wicks, G.; Jantzen, c.; Plodinec, J. (Savannah River Lab., Aiken, SC (USA)). 14 Apr 1988. Contract AC09-76SR00001. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011674/JAW.

The primary objective of the high-level waste management program at the Savannah River Plant (SRP) is to safely and effectively immobilize high-level radioactive defense waste into borosilicate glass. By federal law this glass will ultimately be disposed of in a deep, geologic repository. Thus, it is necessary to demonstrate that the waste glass will perform well in the geologic environment. A multiphase experimental effort, directed at assessing and understanding waste glass behavior under repository conditions, has been in progress at Savannah River Laboratory (SRL) for approximately seven years. Emphasized in this program are waste glass and repoeitory relevant interactions both on a laboratory scale and in field tests. The field or in-situ experiments are exemplified by the burial of over 100 simulated SRL waste glass samples in the granite site at Stripa in Sweden; field tests involving burial of simulated SRL waste glasses in clay at Mol, Belgium; in-situ testing of simulated waste forms from seven different countries and almost 2000 waste form and package component samples buried at the WIPP salt site at Carlsbad, NM; and the burial of SRL waste glasses and natural glass analogues in limestone at Ballidon in the United Kingdom. It is the objective of this report to describe the new SRL in-situ program conducted in the UK. 33 refs., 5 figs., 4 tabs.

35790 **(DPST—88-560) Evaluation of waste tank 16 using a field mercury analyzer.** Looney, B.; Cook, J.R. (Savannah River Lab., Aiken, SC (USA)). 12 May 1988. Contract AC09-76SR00001. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011673/JAW.

Liquid radioactive wastes from the chemical processing of nuclear materials at the Savannah River Plant (SRP) are stored in large tanks buried near the ground surface. Each tank has multiple containment barriers designed to prevent leakage to the surrounding soil and groundwater. The only incident in which waste leaked through the multiple containment of a waste tank at SRP occurred at Tank 16 on September 8, 1960 (Poe, 1974; Prendergast, 1982). Tank 16 was built in 1955 and has a capacity of approximately one million gallons. Tank 16 consists of a steel primary containment vessel resting in a shallow steel pan. A massive concrete encasement surrounds the tank and pan. After the leak in 1960, the tank was removed from service until 1967; at that time it was placed into service for lower activity wastes. In 1972 the tank was removed from service. Subsequently, all of the waste except a sludge heel of 67,000 gallons was removed from the tank. In 1980, this sludge was removed. Following the sludge removal, the tank was exhaustively cleaned and rinsed. Concentrations of radioactivity in the rinsewater suggested that the cleaning of the tank was effective (West and Morris, 1980). Recently, there has been concern about residual nonradioactive constituents, such as mercury, in the tank. To assist in evaluating the potential for residual mercury contamination, a survey method was developed and a survey of several tanks was conducted. 3 refs., 1 tab.

35791 **(EGG-M—34287) State development of new low-level radioactive waste disposal capacity: Progress and issues.** Tait, T.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 17p. (CONF-871076—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006768/JAW.

From 14. World Nuclear Fuel Market annual meeting and international conference on nuclear fuel; San Diego, CA, USA (18 Oct 1987).

The US Department of Energy (DOE) Low-Level Waste Management Program (LLWMP) under the Assistant Secretary for Nuclear Energy (NE) was established in 1981 to facilities the developement and implemenation of an effective nationwide system for the management of commercially generated low-level radioactive waste (LLW). The Low-Level Radioactive Waste Policy Amendments Act (LLRWPAA of 1985) assigned several responsibilites to DOE, including providing tehnical assistance to compact regions, host states, and nonmember states to the extent provided in appropriations acts; and reporting to Congress annually on the status of national LLW management activities and the progress being made by compact regions and states to site new disposal facilities. EG & G Idaho, Inc. is the lead contractor responsible for managing, planning, and conducting assigned tasks in support of the NE LLWMP within the guidelines provided by DOE. 2 figs., 4 tabs.

35792 **(EGG-M—88044) Instrumentation and control for resource management at the INEL.** Polk, R.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 5p. (CONF-8804106—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007709/JAW.

From Pacific Cascade '88; Eugene, OR, USA (26 Apr 1988).

Resource management at facilities dealing with nuclear reactors and waste processing includes the conservation of storage space, reduction of radiation exposure, and improvement of operational efficiency. The application of current control and display technology is a significant asset in the performance improvement of these facilities. Four examples of such applications at the Idaho National Engineering Laboratory (INEL) are presented.

35793 **(EUR—11031) Safety studies of HLW-disposal in the Mors salt dome - Support to the salt option of the Pagis project.** Lindstroem Jensen, K.E. (Commission of the European Communities, Luxembourg). 1987. 88p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752572/JAW.

The study, which is a support to the Pagis project, covers three tasks concerning the evaluation of the Danish salt dome Mors (variant disposal site): evaluation of the human intrusion scenario where a cavern is excavated near the HLW-repository by solution mining technique. The waste is supposed to be leached during the operation period until the abandoned cavern is closed by convergence and the contaminated brine is pressed up into the overburden. Evaluation of the brine intrusion scenario, where the HLW-repository is inadvertently located close to a major brine pocket which subsequently releases its brine content through defects in the repository to the discharge stream for the catchment area. Collection and description of hydrological data of surface and deep layers (down to circa 700 metres) in the repository region. The data will be used by GSF to calculate the radionuclide migration in the geosphere.

35794 **(EUR—11057) Development and active demonstration of acid digestion of burnable plutonium bearing solid wastes. Part. 1. Results. Part 2. Tables and figures.** Wieczorek, H.; Oser, B.; Deckwer, W.D. (Commission of the European Communities, Luxembourg). 1987. 252p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752574/JAW.

The investigations were focused on the active demonstration of the process in a technical scale plant by treatment of 790 kg of waste which contained about 7 kg of plutonium. Complete oxidation of the waste material is achieved within 15 min in sulfuric acid (kept under oxidizing condition by nitric acid) at 250 deg C. At 250 deg C with permanent stirring a rate of plutonium oxide to plutonium sulfate conversion of up to 99.9% is obtained within 8 hours.

The waste oxidation product, besides offgas, is a residue of 320 g per kg waste digested. Precipitation of plutonium is achieved with an efficiency of 88% using cetylpyridinium nitrate. Active process demonstration was performed in a plant of 10 kg capacity per daily run from March 1983 until June 1985. The average waste throughput achieved was 4.1 kg waste per run (maximum 10.4 kg). The plutonium decontamination factors were 10/sup 10/ for the cleaned offgas and 10/sup 6/ for the liquid secondary waste. Tantalum as a potential construction material for the digester does not exhibit specific corrosion; its surface corrosion is 0.1 mm per annum at the maximum.

35795 **(EUR—11069) Pore volume and pore size distribution of cement samples measured by a modified mercury intrusion porosimeter.** Zamorani, E.; Blanchard, H. (Commission of the European Communities, Ispra (IT)). (Commission of the European Communities, Luxembourg). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753951/JAW.

Important parameters for the characterization of cement specimens are mechanical properties and porosity. This work is carried out at the Ispra Establishment of the Joint Research Centre in the scope of the Radioactive Waste Management programme. A commercial Mercury Intrusion Porosimeter was modified in an attempt to improve the performance of the instrument and to provide fast processing of the recorded values: pressure-volume of pores. The dead volume of the instrument was reduced and the possibility of leakage from the moving parts eliminated. In addition, the modification allows an improvement of data acquisition thus increasing data accuracy and reproducibility. In order to test the improved performance of the modified instrument, physical characterizations of cement forms were carried out. Experimental procedures and results are reported.

35796 **(EUR—11081-Vol.2) Potential for creation of a salt dome following disposal of radioactive waste in a salt layer. Volume 2.** Fries, G. (Commission of the European Communities, Luxembourg). 1987. 144p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752575/JAW.

The study aims at quantifying the possibility of creation of a salt dome from a salt layer in which heat-emitting radioactive waste would be buried. Volume 1 describes the results of numerical computer simulations, and of laboratory-scale models in centrifuges. Volume 2 envisages, in a geological perspective, the origin of salt domes, the mechanisms of thei formation, and the associated parameters.

35797 **(EUR—11096) Transport by groundwater of radionuclides released after flooding of a repository in a salt dome.** Glasbergen, P.; De Greef, E.; Hassanizideh, S.M. and others. (RIVM, Bilthoven (NL)). (Commission of the European Communities, Luxembourg). 1987. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753953/JAW.

The transport of radionuclides in geological media by brines of high salinity is studied with the especially-developed METROPOL computer code (Method for the transport of pollutants). This work is part of the Community MIRAGE project, research area No 7 'Modelling studies'.

35798 **(EUR—11305) Measurement of low permeabilities and of pinpoint hydraulic load variations as a function of depth in crystalline formations.** (Commission of the European Communities, Luxembourg). 1987. 143p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753960/JAW.

As part of the programme on management and storage of radioactive wastes, the PIEZOFOR system was improved in two directions, with a view to hydrogeological measurements in low permeability crystalline formations: - the special casing of the boreholes, on the one hand; - the measurement probe, on the other hand. In parallel, a specific software package for automatic interpretation of the measurements was put into operation.

35799 **(GAO/RCED—86-143) Nuclear waste: Impact of Savannah River plant's radioactive waste management practices.** (General Accounting Office, Washington, DC (USA)). 1986. 64p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Radioactivity contained in the environment outside the Savannah River Plant boundary is well within applicable standards. Within the plant boundary, however, some of the surface streams contain elevated levels of radioactivity, and the soil and groundwater at several waste storage and disposal sites are highly contaminated with radioactivity. SRP has taken several actions to reduce radioactive releases into the environment. However, the waste storage and disposal sites may require long-term institutional control. In addition to the actions, SRP is preparing an environmental impact statement to evaluate the effect of its waste management practices on groundwater quality and to assess remedial actions that may be needed.

35800 **(GAO/RCED—86-206FS) Nuclear waste: Quarterly report on DOE's nuclear waste program as of June 30, 1986.** (General Accounting Office, Washington, DC (USA)). 1986. 22p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy's status of nuclear waste program activities for the quarter ending June 30, 1986 included (1) final environmental assessments for first repository sites and recommendations for sites in Nevada, Texas, and Washington for site characterization; (2) postponement of any site-specific work on a second repository; and (3) collection of over $166 million in fecs and investment income.

35801 **(GAO/RCED—87-92) Nuclear waste: DOE should provide more information on monitored retrievable storage.** (General Accounting Office, Washington, DC (USA)). 1987. 70p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy is proposing the construction of a monitored retrievable storage facility primarily for waste preparation and packaging rather than for long-term storage as envisioned by the Nuclear Waste Policy Act. While the MRS would be capable of storing spent fuel for long periods, most of the storage that would take place at the facility would be temporary until the spent fuel could be shipped to the repository. GAO does not believe that DOE's proposal is sufficiently comprehensive for the Congress to make an informed decision on the cost of, need for, or consequences of integrating an MRS into the waste management system, or whether the benefit attributed to the MRS can be better achieved by other means. The Congress needs to be aware of the consequences of not approving an MRS as well as the implications of authorizing it. DOE's proposal does not identify the most effective configuration of the authorized waste management system for the Congress to use as a basis for comparison in deciding if the benefits of the proposed MRS facility are worth its added cost to the waste program.

35802 **(GAO/RCED—87-121) Nuclear waste: A look at current use of funds and cost estimates for the future.** (General Accounting Office, Washington, DC (USA)). 1987. 82p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy has revised its long-range cost estimates for the disposal of spent nuclear fuel and other highly radioactive waste from about $20 billion to between $21 billion and $41 billion. Delays in meeting some program milestones have added to the costs of the program and consequently DOE has proposed a 5-year delay for the first repository to come on-line. These program uncertainties will limit confidence in the estimates for the next several years. One such uncertainty is the estimated quantity of spent fuel for disposal. DOE's estimating approach overstates the amount of spent fuel that utilities will generate and the fees that they will pay into the Nuclear Waste Fund. As a result, DOE may not be collecting fees at a rate that will cover total program costs and may be overbuilding the waste system.

35803 **(GAO/RCED—87-186FS) Nuclear waste: Quarterly report on DOE's nuclear waste program as of June 30, 1987.** (General Accounting Office, Washington, DC (USA)). 1987. 28p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Department of Energy nuclear waste activities during the quarter ending June 30, 1987 include extension of the operational data planned for the first repository from January 1998 to 2003; a proposal to construct and operate a monitored retrievable storage facility in Roane County, Tennessee; and a decision to delay site-specific work for a second repository and begin in 1995 a national survey of potential second repository sites. The Nuclear Waste Fund collected over $170 million in fees and investment income during the quarter and obligated about $31 million for program activities. The fund balance as of June 1987 was about $1.5 billion. During this quarter, several legislative proposals were introduced in the Congress that would redirect or significantly change the nuclear waste management program.

35804 **(IL—232) Study concerning the geological storage of radioactive waste in the Netherlands. Second interim report on phase 1 (January 1986-January 1987).** (Ministerie van Economische Zaken, The Hague (Netherlands). Commissie Opberging te Land). Mar 1987. 113p. (In Dutch). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702273/JAW.

This report presents an intermediate state of affairs in the execution of the first stage of the program of research concerning the geological storage of nuclear waste in the Netherlands (OPLA-program). This first stage consists of desk studies and laboratory investigations in view of the judgement of the desirability of continuation of this program in eventual next steps with field research. 19 refs.; 11 figs.; 1 table.

35805 **(INIS-mf—11132) Cost study on waste management at three model Canadian uranium mines. Final report.** (Kilborn (Saskatchewan) Ltd., Saskatoon (Canada)). Mar 1984. 247p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702090/JAW.

Prepared for the National Uranium Tailings Program.

A waste management cost study was initiated to determine the capital and operating costs of three different uranium waste management systems which incorporate current technologies being used in Canadian uranium mining operations. Cost estimates were to be done to a thirty percent level of accuracy and were to include all waste management related costs of a uranium ore processing facility. Each model is based on an annual uranium production of 1,923,000 kg U (5,000,000 lbs U_3O_8) with a total operating life of 20 years for the facility. The three models, A, B, and C, are based on three different uranium ore grades, 0.10 percent U_3O_8, 0.475 percent U_3O_8 and 1.5 percent U_3O_8 respectively. Yellowcake production is assumed to start in January 1984. Model A is based on a conceptual 7,180 tonne per day uranium ore processing facility and waste management system typical of uranium operations in the Elliot Lake area of northern Ontario with an established infrastructure. Model B is a 1.512 tonne per day operation based on a remote uranium operation typical of the Athabasca Basin properties in northern Saskatchewan. Model C is a 466 tonne per day operation processing a high-grade uranium ore containing arsenic and heavy metal concentrations typical of some northern Saskatchewan deposits.

35806 (INIS-mf—11153, pp 50-55) **6. Radioactive wastes from nuclear power plants.** Neumann, L. 1987. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780081/JAW.

In Nuclear power. CAEC lecturers' manual.

The production of radioactive wastes in nuclear power and the current concept of their disposal are explained. This is based on the so-called multibarrier principle using a system of several barriers each of which barring radioactive materials from penetrating the environment. The types are characterized of radioactive wastes produced by WWER nuclear power plants also used in the CSSR. It is revealed that each WWER-440 unit produces several hundred cubic meters of liquid radioactive concentrates annually containing several hundreds dozen of tons of non-active salts and radionuclides in the amount of an order of 10^{13} Bq. The volume of saturated ion exchangers is lower by about one order, their summation activity is similar or slightly higher. The activity of solid wastes is higher by several orders. Radioactive waste processing and disposal in the CSSR are then treated and very high-level wastes are discussed. The possibilities are briefly outlined of the solution of the nuclear power plant fuel cycle problems with respect to radioactive wastes in future. (Z.M.).

35807 **(INIS-mf—11158) Radium removal from Canadian uranium mining effluents by a radium-selective ion exchange complexer.** (Melis Consulting Engineers Ltd., Saskatoon, Saskatchewan (Canada); Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jul 1984. 148p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702338/JAW.

Prepared for the National Uranium Tailings Program.

A laboratory test program was initiated by the Department of Energy, Mines and Resources as part of the National Uranium Tailings Program to investigate the applicability of a radium-selective ion exchange complexer for removing radium from Canadian uranium mining effluents. The ion exchange complexer was shown to be efficient in removing radium from contaminated water of uranium mining operations, with the ultimate loading capacity of the resin on one type of water treated being determined as approximately 1,600 Bqcm^3 of new resin. The results showed that the resin was effective in removing radium but not any other contaminants.

35808 **(INIS-mf—11161) Report on the collection of data relevant to the Canadian National Uranium Tailings Program.** Smith, A. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Oct 1984. 310p. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88702341/JAW.

In December of 1983, Systemhouse Ltd. was awarded a contract to collect data relevant to the Canadian National Uranium Tailings Program and to convert it into a machine readable format. The work was carried out in four phases, namely, data identification, data collection, data transcription/conversion and data verification. The main priority was to identify as much relevant data as possible. The identified data was priorized against a predefined criteria established in conjunction with the project scientific authority. A total of 428 studies were identified as being relevant. Data from 19 of these were converted to machine-readable format, giving information on 2398 samples from 78 boreholes.

35809 (INIS-mf—11195, pp 1-18) **High level nuclear wastes.** Lopez Perez, B. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW. (CONF-8505386—).

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

The transformations involved in the nuclear fuels during the burn-up at the power nuclear reactors for burn-up levels of 33.000 MWd/th are considered. Graphs and data on the radioactivity variation with the cooling time and heat power of the irradiated fuel are presented. Likewise, the cycle of the fuel in light water reactors is presented and the alternatives for the nuclear waste management are discussed. A brief description of the management of the spent fuel as a high level nuclear waste is shown, explaining the reprocessing and giving data about the fission products and their radioactivities, which must be considered on the vitrification processes. On the final storage of the nuclear waste into depth geological burials, both alternatives are coincident. The countries supporting the reprocessing are indicated and the Spanish programm defined in the Plan Energetico Nacional (PEN) is shortly reviewed. (author) 8 figs., 4 tabs.

35810 (INIS-mf—11195, pp 19-42) **Nature of the glassy state. Implications for radioactive waste storage.** Shackelford, J.F. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW. (CONF-8505386—).

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

Glass is a primary candidate for the storage of radioactive waste. The glassy state is defined in themes of atomic-scale struc-

ture, viz., short-range order (building blocks) and long-range randomness. On the microstructural-scale, these non-crystalline solids may exhit phase separation. Optical and mechanical properties are central to the general structural applications of glasses. Transport properties are of special importance to the use of glasses for nuclear repository. Both gaseous and ionic diffusion can be involved. (author) 9 figs.

35811 (INIS-mf—11195, pp 43-68) **Liquid immiscibility in glasses and nuclear waste management.** Rincon, J.M. (Instituto de Ceramica y Vidrio, Madrid (Spain)). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW. (CONF-8505386—).

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

The glass-in-glass phase separation or liquid immiscibility in glasses has been widely investigated in the past due to its applications in glazes, opal glasses and glass-ceramics. Since that time, the thermodynamics of the miscibility domes in equilibria diagrams, binaries of ternaries, has been established. Nowadays, the immiscibility studies are emerging due to the vitrification of the nuclear wastes and location in adequate geological burial for longer time. The focus of recent researches is to determine the partition ratio of radioelement between different phases separated from different chemical leaching, as well as the miscibility gaps in the Na_2O-B_2O_3-SiO_2 system including one or several elements which could be contained in a high or low level nuclear waste. (author) 14 figs., 2 tabs.

35812 (INIS-mf—11195, pp 95-106) **Formation of NZP ceramics for the immobilization of radionuclides.** Alamo, J. (Valencia Univ. (Spain). Dept de Quimica Inorganica). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW. (CONF-8505386—).

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

The problem of Radioactive Waste Management is briefly outlined from the crystal chemical point of view. Some alternatives (glasses and ceramics) are compared and the synthesis and properties of NZP ceramics are reviewed. (author) 5 figs., 1 tab.

35813 (INIS-mf—11195, pp 121-139) **Chemical durability of silicoborate glasses.** Nieto, M.I.; Rodriguez, M.A.; Rubio, J.; Fernandez, A.; Oteo, J.L. (Instituto de Ceramica y Vidrio, Madrid (Spain)). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW. (CONF-8505386—).

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

A general view of the durability in silicoborate glasses is presented with more emphasis on the etching factors (chemical composition, lattice structure, pH...) the techniques used for this study and the experimental results. Likewise, the research presently developed in this area at the Instituto de Ceramica y Vidrio, CSIC, is related to the applications. Future research in this field is also mentioned. (author) 15 figs.

35814 (INIS-mf—11195, pp 141-178) **Alteration of national glass in radioactive waste repository host rocks: A conceptional review.** Apps, J.A. (Lawrence Berkeley Lab., CA (USA)). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW. (CONF-8505386—).

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

The storage of high level radioactive wastes in host rocks containing natural glass has potential chemical advantages, especially if the initial waste temperatures are as high as 250°C. However, it is not certain how natural glasses will decompose when exposed to an aqueous phase in a repository environment. The hydration and devitrification of both rhyolitic and natural basaltic natural glasses are reviewed in the context of hypothetical thermodynamic phase relations, infrared spectroscopic data and laboratory studies of synthetic glasses exposed to steam. The findings are compared with field observations and laboratory studies of hydrating and devitrifying natural glasses. The peculiarities of the dependence of hydration and devitrification behaviour on compositional variation is noted. There is substantial circumstantial evidence to support the belief that rhyolitic glasses differ from basaltic glasses in their thermodynamic stability and their lattice structure, and that this is manifested by a tendency of the former to hydrate rather than devitrify when exposed to water. Further research remains to be done to confirm the differences in glass structure, and to determine both physically and chemically dependent properties of natural glasses as a function of composition. (author) 7 figs.

35815 (INIS-mf—11195, pp 179-208) **Radiation damage in nuclear waste glass.** DeNatale, J.F. (California Univ., Davis (USA). Dept. of Mechanical Engineering). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW. (CONF-8505386—).

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

Silicate glass is a promising material for the containment of nuclear wastes. The need for an accurate characterization of the waste properties makes an understanding of the radiation response of the glass an important issue. There are a number of ways in which the self-generated radiation may affect the glass, both in terms of its structure and chemistry. There are also a number of different techniques for characterizing these effects and it is important to be aware of their limitations and the significance of these measurements. The radiation damage to simulated nuclear waste glass appears as the decompositition of the glass. This is often accompanied by the formation of sub-micron oxygen bubbles and the development of an amorphous phase separation. This type of damage has been observed under electron, gamma and ion irradiations, and a comparison of the separate responses can be used to quantitatively determine the radiation effect in nuclear waste glasses. (author) 9 figs., 1 tab.

35816 **(INIS-mf—11195) Glasses and glass-ceramics for nuclear waste management.** Rincon Lopaz, J.M. (ed.). (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain); Instituto de Ceramica y Vidrio, Madrid (Spain); Junta de Energia Nuclear, Madrid (Spain)). 1987. vp. (CONF-8505386—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780093/JAW.

From Seminar on the use of glasses and glass-ceramics for nuclear waste management; Madrid, Spain (21 May 1985).

Selected papers have been processed separately for inclusion in the Energy Data Base.

35817 **(INIS-XN—122) International hydrocoin project. Groundwater hydrology modelling strategies for performance assessment of nuclear waste disposal.** (Nuclear Energy Agency, 75 - Paris (France)). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702391/JAW.

The International HYDROCOIN (Hydrologic Code Intercomparison) Project was started in May 1984. Fourteen organizations participate in the Project, with the Swedish Nuclear Power Inspectorate (SKI) as managing participant and the OECD Nuclear Energy Agency (NEA) taking part as a member of the Project secretariat. HYDROCOIN is concerned with the assessment of groundwater movements at potential nuclear waste disposal sites with the help of mathematical models and computer codes. The Project is divided into three levels. The objective of HYDROCOIN Level 1 is to verify the accuracy of groundwater flow codes. HYDROCOIN Level 2 and Level 3 are concerned with validation of hydrological models and uncertainty/sensitivity analysis, respectively. This report, which has been prepared by the NEA Secretariat and SKI in consultation with the co-ordinating group of the HYDROCOIN Project summarizes the background and objectives of the Project and presents the results of the work performed up to the middle of 1987. It is intended to provide general information on HYDROCOIN to interested parties beyond the group of directly involved specialists.

35818 (Juel-Spez—394) Treatment of radioactive waste in the nuclear fuel cycle. Merz, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung). Mar 1987. 173p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753573/JAW.

The report explains the various methods and steps of radioactive waste treatment in the nuclear fuel cycle for interested readers who are not familiar with the subject. The term 'waste management' is illustrated with special regard to the situation in the FRG, and concepts such as reprocessing, direct ultimate disposal of spent fuel elements are explained. Nuclear spent fuel reprocessing is dealt with only as far as it is of significance to the waste management. The report concentrates on the discussion of the various nuclear waste types, and their handling, of reprocessing methods and waste conditioning methods, and of ultimate disposal (in underground geological spaces, on the seafloor, or in trenches). Interim storage, transport, safety and nuclear safeguards are also dealt with in this context. A concise glossary of terms and hints for further reading are attached.

35819 (KFA-DE-IB—3/87) Waste water monitoring in the Juelich Nuclear Research Center in 1986. Zange, E.; Zaddach, G.; Schlenter, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Dekontamination). Apr 1987. 27p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753578/JAW.

Due to slightly increased radioactivity values, two batches of a storage tank of 2000 m^3 had to be decontaminated. Amounts of low-level radioactive waste water increased by 10% as compared with the last year (30 600 m^3 in 1981, 21 500 m^3 in 1986). The volume of low-level waste water collected in the receiver tanks increased by 17% over last year, and by 30% compared with the 1980 volume. Aggregate (β + EC) activity in the low-level liquid effluents was 573 GBq in the reporting year (mean value 559 GBq in the years 1983 to 1985). In 1986, the I-131 radioactivity in the liquid effluents from the medical department was 306 GBq, or 53.4%. All these effluents have again been led to the storage tanks of the TD-DE facilities, for interims storage and decay of short-lived radioactivity. The waste water volume received from external institutions was higher by 9%., and the contents of α-emitters were lower by 62%, of (β + EC)-emitters by 16%, and of tritium by 10%. The decontamination evaporators of KfA Juelich received 3.160 m^3 of liquid effluents in the year under review, with an aggregate activity (without H3) of 262 GBq. The retention coefficient was 99.883%.

35820 (KFK—4324) In-situ corrosion studies on selected high-level waste packaging materials under simulated disposal conditions in rock salt formations. Schwarzkopf, W.; Smailos, E.; Koester, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Jan 1988. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753580/JAW.

This work reports about in situ corrosion experiments on unalloyed steels, Ti 99,8-Pd, Hastelloy C4, and iron-base alloys, as modular cast iron, Ni-Resist D4 and Si-cast iron, under simulated disposal conditions. The experiments were carried out in the frame of the GermanUS Brine Migration Test in heated tubed boreholes in the Asse salt mine at T = 150°C to 210°C, both in the absence and in the presence of a γ-radiation field of 3 x 10^2 Gyh (Co-60 source). In addition, the material used to protect the tubing from corrosion (Inconel 600) as well as the backfill material for the annular gap (Al_2O_3 spheres) were investigated for possible corrosion attack. All materials investigate exhibited high resistance to corrosion under the conditions prevailing in the Brine Migration Test. All material specimens corroded at much lower rates than determined in the previous laboratory-scale tests. All materials and above all the materials with passivating oxide layers such as Ti 99.8-Pd and Hastelloy C4 which may corrode selectively already in the presence of minor amounts of brine had been resistant with respect to any type of local corrosion attack. The γ-radiation of 3 x 10^2 Gyh did not exert an influence on the corrosion behaviour of the materials. No corrosion attacks were observed on the Al_2O_3 spheres. In the case of Inconel 600 traces of sulphur were detected probably resulting from the reaction of Ni with H_2S to NiS. Measurable general and local corrosion, however, have not been observed. (orig.IHOE).

35821 (LA—11246-MS) Preliminary report on the statistical evaluation of sorption data: Sorption as a function of mineralogy, temperature, time, and particle size. Beckman, R.; Thomas, K.; Crowe, B. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 26p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009204/JAW.

This report studies the transport of radionuclides from a repository to the environment by dissolution of the stored solid-waste form and subsequent transport in water. The sorption process may retard this movement of radionuclides from the repository to the accessible environment. A measure of this retardation process is the sorption ratio, R/sub D/, where R/sub D/ = (activity in solid phase per unit mass of solid)(activity in solution per unit volume of solution). In this study, predictions of the R/sub D/ values for the elements barium, cerium, cesium, europium, and strontium are developed from linear regression techniques. An R/sub D/ value was obtained for numerous drill core samples. Additional data include the particle size of the rock, temperature condition during the experiment, concentration of the sorbing element, and length of the sorption experiment. Preliminary regression results based on these data show that the temperature and length of the experiment are the most significant factors influencing the R/sub D/ values. Particle size has a slight effect, and based on a small amount of data, it appears that concentration had no effect. The x-ray diffraction data are used to classify the samples by mineralogy, and regression techniques are used to develop estimates of the R/sub D/ values. Zeolite abundance of 10% or more with some addition of clay increases the sorption values significantly. 12 refs., 3 figs., 6 tabs.

35822 (LA—11289-MS) A preliminary comparison of mineral deposits in faults near Yucca Mountain, Nevada, with possible analogs. Vaniman, D.T.; Bish, D.L.; Chipera, S. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 59p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010486/JAW.

Several faults near Yucca Mountain, Nevada, contain abundant calcite and opal-CT, with lesser amounts of opal-A and sepiolite or smectite. These secondary minerals are being studied to determine the directions, amounts, and timing of transport involved in their formation. Such information is important for evaluating the future performances of a potential high-level nuclear waste repository beneath Yucca Mountain. This report is a preliminary assessment of how those minerals were formed. Possible analog deposits from known hydrothermal veins, warm springs, cold springs or seeps, soils, and aeolian sands were studied by petrographic and x-ray diffraction methods for comparison with the minerals deposited in the faults; there are major mineralogic differences in all of these environments except in the aeolian sands and in some cold seeps. Preliminary conclusions are that the deposits in the faults and in the sand ramps are closely related, and that the process of deposition did not require upward transport from depth. 35 refs., 25 figs.

35823 (LA—11292-MS) Mineralogy of drill hole UE-25p#1 at Yucca Mountain, Nevada. Chipera, S.J.; Bish, D.L. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010487/JAW.

Drill hole UE-25p{number←sign}1 is located east of the candidate repository block at Yucca Mountain, Nevada, and as such provides information on the geology of the accessible environment. The hole was drilled to a depth of 1807 m (5923 ft) and is unique in that it penetrates tuffs that are older than any volcanic units previously encountered in drill holes at Yucca Mountain. In addition, it is the only hole drilled to date that penetrates the base of the tuff sequence and enters the underlying Paleozoic dolomite basement. We have examined the mineralogy of drill cuttings, core, and sidewall samples from drill hole UE-25p{number←sign}1 is similar to that in the other drill holes examined at Yucca Mountain. The only significant differences in mineralogy from other drill holes include the presence of dolomite in the Paleozoic carbonate

rocks and the occurrence of up to 3% laumontite, a Ca-zeolite, in four samples of the Lithic Ridge Tuff. 15 refs., 5 figs., 4 tabs.

35824 **(LA—11293-MS) Statistical guidelines for planning a limited drilling program.** Campbell, K. (Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 51p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010488/JAW.

Site characterization for potential nuclear waste repository at Yucca Mountain in south-central Nevada will include the construction of a limited number of new drill holes to depths below the repository horizon from which information about the properties of the surrounding and underlying tuffs can be obtained. Quantitative techniques to estimate the amount of information to be gained from a proposed drilling plan are developed. These estimates are to be compared with economic costs and with risk analysis requirements for the potential repository. In some cases the existing data, although extremely limited, are sufficient for preliminary application of these methods. 33 refs., 19 figs., 3 tabs.

35825 **(LBL—21697) Transient and steady-state radionuclide transport through penetrations in nuclear waste containers.** Chambre, P.L.; Lee, W.W.L.; Kim, C.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Dec 1986. Contract AC03-76SF00098. 11p. (CONF-861207—117). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012014/JAW.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In this paper we analyze the transport of radionuclides through penetrations in nuclear waste containers. Penetrations may result from corrosion or cracks and may occur in the original container material, in degraded or corroded material, or in deposits of corrosion products. We do not consider how these penetrations occur or the characteristics of expected penetrations in waste containers. We are concerned only with the analytical formulation and solutions of equations to predict rates of mass transfer through penetrations of specified size and geometry. Expressions for the diffusive mass transfer rates through apertures are presented. We present numerical illustrations for steady-state mass-transfer rates through a circular hole, including concentration isopleths. The results are extended to multiple holes, including a criterion for hole spacing wherein superposition of single-hole solutions can be used. Results illustrated for holes in thin-walled containers show that significant mass transfer can occur even if a small fraction of the container area is perforated. We also illustrate the case of holes facing a water gap, instead of being in intimate contact with porous rock. In this case the radionuclide flux from many small holes approaches that from a bare waste cylinder.

35826 **(LBL—24599-Rev.) Mass transfer and transport in geologic repositories: Analytical studies and applications.** Pigford, T.H.; Chambre, P.L.; Lee, W.W.L. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 6p. (CONF-880601—19-Rev.; CONF-880601—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009833/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Assessing the long-term performance of geologic repositories for radioactive waste requires reliable quantitative predictions of rates of release of radionuclides from the waste into the rock, transport through the geologic media, cumulative release to the accessible environment, and maximum concentrations in ground water and surface water. Here we summarize our mass transfer approach to making these predictions. 32 refs.

35827 **(LBL—24796) Estimating properties of unsaturated fractured formations from injection and falloff tests.** Mishra, S.; Bodvarsson, G.S.; Attanayake, M.P. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 54p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008398/JAW.

A new technique for calculating hydraulic properties of unsaturated fractured formations is proposed as an alternative to the common approach involving steady-state analysis of multi-rate gas injection tests. This method is based on graphical analysis of unsteady-state pressure-time data from an injection-falloff test sequence. Both gas and water injection testing are considered. Flow in a horizontal fracture of limited lateral extent, bounded above and below by an impermeable matrix, and intersected by a cylindrical borehole is described by two analytical models developed in this study. The first model corresponds to the early-time infinite acting radial flow period, and the second to the late-time linear flow period. Interpretive equations are derived for computing fracture conductivity and volumetric aperture from early-time pressure data, and fracture width from late-time pressure data. Effects of fracture inclination and gravity are studied numerically and found to be practically negligible for gas as well as water injection. Two simulated injection-falloff tests are analyzed using the suggested procedure. Results are found to be in good agreement with simulator input values. 13 refs., 14 figs., 4 tabs.

35828 **(MLM—3493) Glass furnace processing of Rocky Flats Plant wastes: An evaluation.** Klingler, L.M.; Abellera, P.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 29 Apr 1988. Contract AC04-76DP00053. 58p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010333/JAW.

This report evaluates the use of a joule-heated glass furnace to treat four Rocky Flats Plant waste streams. These streams are extremely large, are primarily water soluble inorganic salts, and can be contaminated with hazardous organic material, toxics, andor radioactivity. It runs closely simulating actual process type runs, the glass furnace effectively treated these wastes by degrading the salts to oxides that can be incorporated along with radioactivity and toxic metals into a highly stable glass matrix. Most of the gaseous by-products of the waste treatment can be handled by a wet offgas scrubbing system. Two major exceptions are NO/sub x/ and volatile organics. This study has provided additional evidence that NO/sub x/ can be adequately controlled by means of the adding NH_3 to the gases in the furnace chamber. To prepare glass with optimum characteristics, batch compositions were computer selected for this study. The quantities of glass-making chemical additives required to prepare glass to this formulation effectively eliminated any process volume reduction potential for some of the wastes. 1 ref., 17 figs., 20 tabs.

35829 (NAGRA-NTB—87-15, pp 271-286) **Overview of Nagra's geological investigation programme in Northern Switzerland.** Thury, M.; Diebold, P. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland); Herznach (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

For the assessment of the feasibility and safety of a repository for high level radioactive waste, Nagra (National Cooperative for the Storage of Radioactive Waste) has started in 1980 in central Northern Switzerland an extensive geological investigation program. This overall program contains four field investigation programs and several programs for synthesis work. By the end of 1985, six deep drillings have been completed. The deepest borehole reached 2482 m. All in all, more than 8000 m of cores have been taken and analyzed in detail. In the boreholes, extensive hydrogeological tests have been carried out. Within the regional geophysical investigation program gravimetric, aeromagnetic and magnetotelluric, refraction seismic and reflection seismic surveys have been carried out. Vibroseis lines of 400 km length have been measured. Within the regional hydrogeological program, water samples of more than 100 springs and wells with hydrochemically or thermally abnormal waters have been analyzed in detail for their chemical and isotopic composition. Within the neotectonic program, geomorphologic, tectonic, geodetic and seismic studies and measurements have been carried out. In 1983, a microearthquake survey network was installed. All these data were analyzed in several synthetic programs: Structural geology, hydrochemistry, hydrodynamic modelling and long term stability scenarios. The Nagra program continues. As next, a deep borehole in the Canton of Schaffhausen is planned. Meanwhile all data were analyzed in detail and the understanding of the regional and local geology, geochemistry and hy-

drogeology of northern Switzerland is improved and refined. (author) 32 refs., 8 figs.

35830 (NSS/R—102) Nirex safety assessment research programme for 1987/1988. Cooper, M.J.; Tasker, P.W. (United Kingdom Nirex, Ltd.; UKAEA Harwell Lab. Materials Physics and Metallurgy Div.). Oct 1987. 56p. (AERE-R—12816). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753611/JAW.

This report outlines the work of the Nirex Safety Assessment Research Programme during the period 1st April 1987 to 31st March 1988. The research programme has the specific objective of providing the information requirements of the post-emplacement radiological safety case for the disposal of low-level and intermediate-level radioactive waste in underground repositories. For convenience the programme has been divided into seven areas: physical containment, near-field radionuclide chemistry, evolution of the near-field aqueous environment, mass transfer in the geosphere, the biosphere, gas evolution and migration, and integrated studies. The near-field includes the waste, its immobilising medium, its container, the engineered structure in which the container is emplaced and the immediately adjacent geological formation disturbed by the construction of the repository.

35831 (NSS/R—105) Autogenous healing of cracks in concrete and its relevance to radwaste repositories. Guppy, R. (UKAEA Harwell Lab. Materials Development Div.). (United Kingdom Nirex, Ltd.). Mar 1988. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753994/JAW.

Cracks in concrete structures within a radioactive waste repository could provide fast transport pathways and as such could impair the performance of the concrete as a barrier to radionuclide migration. It has been widely reported that cracks in concrete can heal and, therefore, the evidence in support of this phenomenon has been reviewed and its relevance to a concrete barrier in a radioactive waste repository assessed. The mechanism of crack healing is not understood, but the most likely process responsible is calcite formation under wet conditions. There is doubt concerning whether the conditions in a repository will be suitable for crack healing; especially if the cement is extensively modified with slag or fuel ash. It is concluded that further experimental work is required to assess the impact of this phenomenon on the behaviour of cracks in repositories.

35832 (NSS/R—108) Comparative study of the pore structures and surfaces of hardened cement pastes of potential use in radioactive waste repositories. Rowan, S.M.; Donaldson, L.; White, S. (Trent Polytechnic, Nottingham (UK)). (United Kingdom Nirex, Ltd.; UKAEA Harwell Lab. Chemistry Div.). Feb 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753995/JAW.

Measurements of water vapour adsorption at 20°C and mercury intrusion have been used to compare the surfaces and pore structures of hardened cement pastes made from ordinary portland cement (OPC) and the additives blast furnace slag (BFS) and pulverised fuel ash (PFA). The results suggest that each additive, after taking part in the hydration reaction with OPC, produces a paste whose gel pore structure is similar to that derived from OPC alone. The BET adsorption surface area of the cement pastes, in the form of half inch diameter coupons was ca. 55 $m^2 g^{-1}$ and was not influenced by the presence of the additives. However the pastes containing the additives have a larger and better interconnected meso and macropore structure than OPC which may account for larger diffusion coefficients reported elsewhere for caesium ions passing through concrete containing BFS in comparison with a concrete containing OPC alone.

35833 (NSS/R—109) Experimental study of solute transport in mudstones. Gilling, D.; Jefferies, N.L.; Lineham, T.R. (United Kingdom Nirex, Ltd.; UKAEA Harwell Lab. Chemistry Div.). Dec 1987. 59p. (AERE-R—12809). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753612/JAW.

Aqueous phase mass transport is considered to be the most likely means by which radionuclides released from an underground radioactive waste repository may return to man and to the environment. One of the options that has been considered by UK Nirex Ltd. for the disposal of radioactive waste is burial in clay-rich sedimentary formations. This report describes experimental techniques developed for the measurement of diffusivity, hydraulic conductivity and solute-accessible porosity in mudstones. In addition, these parameters have been determined for London Clay and the relative importance of diffusive and convective transport in this formation is discussed.

35834 (NUREG—1318) Technical position on items and activities in the high-level waste geologic repository program subject to quality assurance requirements. Duncan, A.B.; Bilhorn, S.G.; Kennedy, J.E. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of High-Level Nuclear Waste Management). Apr 1988. 26p. NTIS, PC A03/MF A01 - GPO. Order Number TI88009805/JAW.

This document provides guidance on how to identify items and activities subject to Quality Assurance in the high-level nuclear waste repository program for pre-closure and post-closure phases of the repository. In the pre-closure phase, structures, systems and components essential to the prevention or mitigation of an accident that could result in an off-site radiation dose of 0.5rem or greater are termed "important to safety". In the post-closure phase, the barriers which are relied on to meet the containment and isolation requirements are defined as "important to waste isolation". These structures, systems, components, and barriers, and the activities related to their characterization, design, construction, and operation are required to meet quality assurance (QA) criteria to provide confidence in the performance of the geologic repository. The list of structures, systems, and components important to safety and engineered barriers important to waste isolation is referred to as the "Q-List" and lies within the scope of the QA program. 10 refs.

35835 (NUREG/CR—4735-Vol.3) Evaluation and compilation of DOE waste package test data: Biannual report, February 1987–July 1987. Interrante, C.; Escalante, E.; Fraker, A.; Hall, D.; Harrison, S.; Liggett, W.; Linzer, M.; Ricker, R.; Ruspi, J.; Shull, R. (National Bureau of Standards, Washington, DC (USA). Metallurgy Div.). May 1988. 159p. NTIS, PC A08/MF A01 - GPO;1. Order Number TI88011119/JAW.

The waste package is a proposed engineering barrier that is part of a permanent repository for HLW. Metal alloys are the principal barriers within the engineered system. Technical discussions are given for the corrosion of metals proposed for the canister, particularly carbon steels, stainless steels, and copper. The current level of understanding of several canister materials is questioned for the candidate repository in tuff. Three issues are addressed, the possibility of the stress-induced failure of Zircaloy, the possible corrosion of copper and copper alloys, and the lack of site-specific characterization data. Discussions are given on problems concerning localized corrosion and environmentally assisted cracking of AISI 1020 steel at elevated temperatures (150{degree}C). For the proposed salt site, the importance of the duration of corrosion tests and some of the conditions that may preclude prompt initiation of needed long-term testing are two issues that are discussed. 31 refs., 5 figs.

35836 (ORNL/Sub—86-SA094/2) Use of transportable storage casks in the nuclear waste management system: Appendices. (H and R Technical Associates, Inc., Oak Ridge, TN (USA); Johnson (E.R.) Associates, Inc., Oakton, VA (USA)). Dec 1987. Contract AC05-84OR21400. 203p. (ORNL/Sub—86-SA224/2; HR/JAI—289). NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88007846/JAW.

A study was performed to determine the viability of the use of transportable storage casks (TSCs), and other metal casks that are designed primarily for storage but which might be used to ship their stored contents to DOE on a one-time use basis (referred to in this study as storage only casks, or SOCs), in the combined utility/DOE spent fuel management system. The viability of the use of TSCs and SOCs was assessed in terms of the costs and savings involved in their use, the sensitivity of these costs and savings to

changes in the capacity and cost of fabrication of the casks, the impacts of variation in cask design features on cost and radiation exposure of personnel, and their prospective use in connection with the transport of defense high level wastes. Estimates were developed of the costs of acquiring and handling of TSCs and SOCs at reactor sites. For comparison purposes, similar costs were developed for the use of concrete storage casks at reactor sites. Estimates of the savings involved to the DOE system as a result of receiving spent fuel in TSCs or SOCs were separately developed. These costs are developed and presented in Volume 2, Appendices A through J.

35837 **(ORNL/TM—10221) Identification of sites for the low-level waste disposal development and demonstration program.** Ketelle, R.H.; Lee, D.W. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010757/JAW.

This report presents the results of site selection studies for potential low-level radioactive waste disposal sites on the Oak Ridge Reservation (ORR). Summaries of the site selection procedures used and results of previous site selection studies on the ORR are included. This report includes recommendations of sites for demonstration of shallow land burial using engineered trench designs and demonstration of above-grade disposal using design concepts similar to those used in tumulus disposal. The site selection study, like its predecessor (ORNL/TM-9717, Use of DOE Site Selection Criteria for Screening Low-Level Waste Disposal Sites on the Oak Ridge Reservation), involved application of exclusionary site screening criteria to the region of interest to eliminate unacceptable areas from consideration. Also like the previous study, the region of interest for this study was limited to the Oak Ridge Department of Energy Reservation. Reconnaissance-level environmental data were used in the study, and field inspections of candidate sites were made to verify the available reconnaissance data. Five candidate sites, all underlain by Knox dolomite residuum and bedrock, were identified for possible development of shallow land burial facilities. Of the five candidate sites, the West Chestnut site was judged to be best suited for deployment of the shallow land burial technology. Three candidate sites, all underlain by the Conasauga Group in Bear Creek Valley, were identified for possible development of above-grade disposal technologies. Of the three sites identified, the Central Bear Creek Valley site lying between State Route 95 and Gum Hollow Road was ranked most favorable for deployment of the above-grade disposal technology.

35838 **(ORNL/TM—10477) Airborne waste management technology applicable for use in reprocessing plants for control of iodine and other off-gas constituents.** Jubin, R.T. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 68p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88007867/JAW.

Extensive work in the area of iodine removal from reprocessing plant off-gas streams using various types of solid sorbent materials has been conducted worldwide over the past two decades. This work has focused on the use of carbon filters, primarily for power plant applications. More recently, the use of silver-containing sorbents has been the subject of considerable research. The most recent work in the United States has addressed the use of silver-exchanged faujasites and mordenites. The chemical reactions of iodine with silver on the sorbent are not well defined, but it is generally believed that chemisorbed iodides and iodates are formed. The process for iodine recovery generally involves passage of the iodine-laden gas stream through a packed bed of the adsorbent material preheated to a temperature of about 150{degree}C. Most iodine removal system designs utilizing silver-containing solid sorbents assume only a 30 to 50% silver utilization. Based on laboratory tests, potentially 60 to 70% of the silver contained in the sorbents can be reacted with iodine. To overcome the high cost of silver associated with these materials, various approaches have been explored. Among these are the regeneration of the silver-containing sorbent by stripping the iodine and trapping the iodine on a sorbent that has undergone only partial silver exchange and is capable of attaining a much higher silver utilization. This summary report describes the US work in regeneration of iodine-loaded solid sorbent material. In addition, the report discusses the broader subject of plant off-gas treatment including system design. The off-gas technologies to recovery No/sub x/ and to recover and dispose of Kr, ^{14}C, and I are described as to their impacts on the design of an integrated off-gas system. The effect of ventilation philosophy for the reprocessing plant is discussed as an integral part of the overall treatment philosophy of the plant off-gas. 103 refs., 5 figs., 8 tabs.

35839 **(ORNL/TM—10773) Comparison of results based on a deterministic versus a statistical uncertainty analysis.** Maerker, R.E. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 78p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010751/JAW.

A deterministic method for performing an uncertainty analysis is applied to the results of a system of three codes previously analyzed by purely statistical means. This new method propagates joint probabilities through computer models to obtain the distributions of model results by linear extrapolation from a pool of several gradient-enhanced reference runs. Results employing various options in the method are tested against those from the earlier statistical treatment. Both point-by-point and cumulative distribution comparisons were generally performed. The effort leads to the conclusion that in the present application 15 gradient enhanced runs provide virtually as much uncertainty information as 200 statistical executions of the code system, and this feature of the analysis is expected to remain generally valid for most types of problems. The avantage of significant reduction in the number if reference runs required by the deterministic method is partially offset by the longer execution times of the enhanced versions of the codes, however. Thus efficient derivative-taking algorithms will be necessary to insure cost efectiveness. 6 refs., 25 figs., 17 tabs.

35840 **(PNL—5577-10) Fabrication and characterization of MCC [Materials Characterization Center] approved testing material: ATM-10 glass.** Maupin, G.D.; Bowen, W.M.; Daniel, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 89p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88009441/JAW.

The Materials Characterization Center ATM-10 glass represents a reference commercial high-level waste form similar to that which will be produced by the West Valley Nuclear Service Co. Inc., West Valley, New York. The target composition and acceptable range of composition were defined by the sponsor, West Valley Nuclear Service. The ATM-10 glass was produced in accordance with the Pacific Northwest Laboratory QA Manual for License-Related Programs, MCC technical procedures, and MCC QA Plan that were in effect during the course of the work. The method and procedure to be used in the fabrication and characterization of the ATM-10 glass were specified in two run plans for glass preparation and a characterization plan. All of the ATM-10 glass was produced in the form of bars 1.9 {times} 1.9 {times} 10 cm nominal size, and 93 g nominal mass. A total of 15 bars of ATM-10 glass weighing 1394 g was produced. The production bars were characterized to determine the mean composition, oxidation state, and microstructure of the ATM-10 product. Table A summarizes the characterization results. The ATM-10 glass meets all specifications. The elemental composition and oxidation state of the glass are within the specifications of the client. Visually, the ATM-10 glass bars appear uniformly glassy and generally without exterior features. Microscopic examination revealed low (less than 2 wt %) concentractions of 3-μm iron-chrome (suspected spinel) crystals and {approximately}0.5-μm ruthenium inclusions scattered randomly throughout the glassy matrix. Closed porosity, with pores ranging in diameter from 5 to 250 μm, was observed in all samples. 4 refs., 10 figs., 21 tabs.

35841 **(PNL—6320-2) LFCM [liquid-fed ceramic melter] vitrification technology: Quarterly progress report, January--March 1987.** Brouns, R. A.; Allen, C. R.; Powell, J. A. (comps.). (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 86p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88011538/JAW.

This report is compiled by the Nuclear Waste Treatment Program and the Hanford Waste Vitrification Program at Pacific Northwest Laboratory to describe the progress in developing, testing, applying and documenting liquid-fed ceramic melter vitrifica-

tion technology. Progress in the following technical subject areas during the second quarter of FY 1987 is discussed: melting process chemistry and glass development, feed preparation and transfer systems, melter systems, canister filling and handling systems, and process/product modeling. 23 refs., 14 figs., 10 tabs.

35842 **(PNL—6381) A synthesis of ethnohistorical materials concerning the administration of Federal Indian policy among the Yakima, Umatilla, and Nez Perce Indian people: Working draft.** Liebow, E.B.; Younger, C.A.; Broyles, J.A. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Nov 1987. Contract AC06-76RL01830. 45p. (BHARC—800/87/022). NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88007884/JAW.

For the purposes of the Nuclear Waste Policy Act, the Confederated Tribes and Bands of the Yakima Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe have been accorded the status of "Affected Indian Tribe" and have become party to the proceedings to determine a suitable location for the nation's first commercial waste repository. Each of the Tribes has expressed concerns about the suitability of the Hanford Site in eastern Washington. These concerns, in general, address the proposed repository's effects on traditional spiritual beliefs and cultural practices, on tribal sovereignty and the Tribes' right to self-government, on the natural resources under tribal management jurisdiction, and on the health and socioeconomic characteristics of the Tribes' reservation communities. The Yakima, Umatilla, and Nez Perce have distinctive cultural traditions that may be adversely affected by activities related to the Basalt Waste Isolation Project (BWIP). Further, the Tribes enjoy a unique relationship with the federal government. Because of their distinctive cultures and governmental status, particular attention will be paid to expressed interests of the Tribes, and to ways in which these interests may be affected by the repository program. Monitoring is needed to describe current conditions among the Affected Tribes' populations, to describe BWIP site characterization activities affecting the Tribes, and to measure any changes in these conditions that may occur as a direct result of site characterization. This paper reports our first efforts at gathering historical information. It summarizes materials contained in two sources: the reports of field agents to the Commissioner of Indian Affairs (1854-1936), and the dockets of the Indian Claims Commission. 24 refs., 3 figs.

35843 **(PNL—6383) Community interviews task report: Working draft: BWIP [Basalt Waste Isolation Project] Repository Project.** Bolton, P.A. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Nov 1987. Contract AC06-76RL01830. 14p. (BHARC—800/87/025). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008049/JAW.

The socioeconomic program for the Basalt Waste Isolation Project (BWIP) requires the collection of information about economic, social and cultural conditions, demographic, housing and settlement patterns, and the provision of public services and facilities in order to monitor and assess the impacts of the project on the study area. Much of the information needed by the socioeconomic program is compiled, maintained, and used by officials or staff members of local, regional, state, or tribal agencies or organizations. Because much of this information is prepared for internal use, the documents are often not published or advertised and it can be difficult for researchers to identify many obscure, yet useful, sources of information. In order to identify and gain access to this information, it is often most efficient to talk directly with officials and staff members of pertinent agencies or organizations who may have knowledge of these documents or who may have useful information themselves. Consequently, interviews in the study communities with persons knowledgeable about the socioeconomic or sociocultural characteristics of the area constitute an important source of data for the socioeconomic program. In addition to identifying various data sources, these interviews provide a mechanism for understanding and interpreting those data. Knowledge of specific local conditions is often necessary to correctly interpret quantitative data. The purpose of this paper is to summarize the objectives of the community interviews task and the general methods that will be used in conducting the community interviews. 3 refs.

35844 **(PNL—6384) Interim facilities and services profile, Benton and Franklin Counties, Washington: Working draft.** Friedli, E.A. (Battelle Human Affairs Research Centers, Washington, DC (USA)). Nov 1987. Contract AC06-76RL01830. 39p. (BHARC—800/87/027). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007883/JAW.

This report focuses on measures of supply and demand for key facilities and services and provides a summary of 1985 conditions in education (public schools and libraries), public safety (police and sheriff, correction facilities, courts, and fire departments), health care and social services, and infrastructure (streets and roads, water and waste, and parks and recreation). These facilities and services are provided by public entities for use by the general public. In most cases, the providing agencies are funded by tax dollars and governed by elected representatives. As is generally demonstrated in this section none of the areas presented reveals demands for facilites and services in excess of current supply. In the area of education, the study area is providing service slightly above the state average by spending $1812 per pupil for certificated staff salaries (the state average is $1789), and enrollment levels are below capacity. Public safety also appears to be adequately covered with approximately 1.5 police officers per 1000 people and 0.75 fire fighters per 1000 people. One potential concern is that the Benton County correctional facility is currently being run at its capacity level. Health facilites, with the major hospitals operating at less than half capacity, appear to be adequate to meet the needs of the population. Infrastructure also appears to be adequate. Water and waste facilities have been expanded in recent years. However, this report is based on data for a single year and does not include historical trends. As the monitoring program continues, historical data will be collected and presented in order to put the information presented here in an historical perspective. 55 refs., 4 figs., 12 tabs.

35845 **(PNL—6390) Interim housing conditions profile, Benton and Franklin Counties, Washington: BWIP Repository Project: Working draft.** Bolton, P.A. (Battelle Human Affairs Research Centers, Washington, DC (USA)). Nov 1987. Contract AC06-76RL01830. 34p. (BHARC—800/87/026). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007984/JAW.

This report describes the housing stock and its availability in Benton and Franklin counties. Depending on the specific measures, data are presented for the entire MSA, for Benton and Franklin counties separately, for incorporated and unincorporated areas within the counties, and for specific incorporated areas. The most detailed data are available for the two counties and for the major cities of Kennewick and Richland in Benton County and Pasco in Franklin County. In 1986, 64 percent of the population of Benton County and 66 percent of the housing units were in Kennewick and Richland. Seventy-three percent of the population and 75 percent of the housing were in the incorporated area of Benton County. In Franklin County, Pasco accounted for 52 percent of the county's 1986 population and 57 percent of its housing. Fifty-nine percent of the population and 63 percent of the housing were in the incorporated areas of Franklin County. More detailed data are needed to fully describe the housing conditions in the jurisdictions described here. 13 refs., 9 tabs.

35846 **(PNL—6497) Water quality: Historic values and impact of drilling activities during FY 1988 at the reference repository location in southeastern Washington.** Eddy, P.A.; Teel, S.S.; Raymond, J.R.; Bierschenk, W.H. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 57p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008068/JAW.

The purpose of the Environmental Monitoring Program was to monitor the characterization activities related to the Basalt Waste Isolation Project (BWIP) at boreholes DC-24CX and DC-25CX and document any environmental impacts as a result of these activities including contamination and/or degradation of the aquifer water quality from the invasion of drilling fluids into the formation and surface contamination from the disposal of drilling fluid at the land surface. The first phase of this program involved describing the baseline water quality at the Reference Repository Location (RRL) including data for spring and surface waters, and both the

unconfined and confined aquifers. The second phase involved the collection and analysis of samples collected during drilling operations at wells DC-24CX and DC-25CX. Five surface water and 25 spring sampling sites were designated for chemical and radiological background data collection for BWIP. Chemical and radiological background data from 61 wells that obtain water from the unconfined aquifers indicate that the chemistry of these aquifers is similar to the spring and surface water samples. However, some of the wells show contamination from existing operations and past operations of various facilities on the Hanford Site. These contaminants are both chemical and radiological in nature with nitrate as the primary chemical constituent and tritium as the major radiological constituent. 20 refs., 9 figs., 8 tabs.

35847 **(PNL—6499) BWIP [Battelle Waste Isolation Program] Repository Project: Interim fiscal profile, Benton and Franklin counties, Washington: Working draft.** Dong, F.B.; Dugan, M.K.; Clark, D.C. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Feb 1988. Contract AC06-76RL01830. 65p. (BHARC—800/87/028). NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008056/JAW.

This report presents a fiscal profile of Benton and Franklin counties, and of the cities of Richland, Kennewick, and Pasco. Overall, changes in operating revenues and expenditures in these jurisdictions have corresponded with changes in the local economy. The combined operating expenditures of Benton County, Franklin County, Kennewick, Pasco, and Richland, expressed in current dollars, tripled between 1975 and 1985, increasing from $18.1 million to $55.0 million, an annual average increase of 11.8 percent. During this time, the population of the Benton-Franklin MSA increased from 100,000 to 140,900 people, and the national all-items price index for urban consumers doubled, increasing from 161.2 to 322.2. Adjusted for inflation, per capita expenditures by these governments increased only slightly during this period, from $361.8 in 1975 to $390.3 in 1985. Employment in the Benton-Franklin MSA rose from 40,080 workers in 1970 to a peak of 75,900 in 1981 before declining to 61,100 in 1985, primarily due to the loss of 9,928 jobs in the Washington Public Power Supply System after 1981. The MSA's population followed a similar trend, with a slight lag. In 1970, total population in the Benton-Franklin MSA was 93,356 people. The MSA's population grew rapidly during the late 1970s, reached a peak of 147,900 persons in 1982, and then declined to 139,300 in 1986. 23 refs., 16 figs., 14 tabs.

35848 **(PNL—6505) Project characteristics monitoring report: BWIP [Basalt Waste Isolation Program] repository project.** Friedli, E.A.; Herborn, D.I.; Taylor, C.D.; Tomlinson, K.M. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Mar 1988. Contract AC06-76RL01830. 64p. (BHARC—800/88/004). NTIS, PC A04;3. Order Number DE88010588/JAW.

This monitoring report has been prepared to show compliance with provisions of the Nuclear Waste Policy Act of 1982 (NWPA) and to provide local and state government agencies with information concerning the Basalt Waste Isolation Program (BWIP). This report contains data for the time period May 26, 1986 to February 1988. The data include employment figures, salaries, project purchases, taxes and fees paid, worker survey results, and project closedown personal interview summaries. This information has become particularly important since the decision in December 1987 to stop all BWIP activities except those for site reclamation. The Nuclear Waste Policy Amendments Act of 1987 requires nonreclamation work at the Hanford Site to stop as of March 22, 1988. 7 refs., 6 figs., 28 tabs.

35849 **(PNL—6541) An interim evaluation of the thermal stability of Cu--Y--^{85}Kr sputter deposits and plans for evantual disposal.** McClanahan, E.D.; Bradley, E.R. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 23p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010330/JAW.

A pilot process was developed and demonstrated for trapping and storing ^{85}Kr from the dissolver off-gas stream of a nuclear fuel reprocessing plant. Ions produced in a low-pressure krypton discharge are implanted on the inner wall of a krypton trapping storage device (KTSD). Objectives were to measure the release of ^{85}Kr implanted in a copper--yttrium alloy, outline the characterization work to be performed on the Cu{endash}Y{endash}^{85}Kr waste form, and identify the options available for disposing of the remaining ^{85}Kr. Release rates were obtained from periodic measurements of the krypton released from both radioactive and nonradioactive krypton-loaded KTSDs. Sampling is expected to continue as long as the extrapolated release rates remain acceptable for a period not to exceed one half-life ({approximately}10 y). Seven tests were performed on a nonradioactive KTSD at 180 to 450{degree}C. Three KTSDs loaded with 80 to 150 Ci of ^{85}Kr stored at 150, 250, and 350{degree}C were sampled four times each. Proposed post-elevated-temperature storage characterization of the Cu{endash}Y{endash}^{85}Kr waste form is outlined. Both radioactive and nonradioactive test specimens stored below 350{degree}C showed release rates less than 0.1%y/sup {minus}1/. Release rates for the radioactive specimens were obtained for storage periods of 1.6, 1.1, and 0.4 y at 150, 250 and 350{degree}C. The nonradioactive specimen has been held at temperatures between 180 and 450{degree}C, but mainly at 350{degree}C for a total storage time of 2.1 y. Tests should continue for a period not exceeding 10 y, and then the remaining Cu{endash}Y{endash}^{85}Kr waste form should be evaluated to better predict the overall stability. Three options for the disposal of the remaining ^{85}Kr. 3 refs., 2 figs., 2 tabs.

35850 **(PNL-SA—15143) Validation of a nuclear waste repository performance assessment model: Comparison of theory with experiment.** Geldart, R.W.; McGrail, B.P.; Rhoads, K.; Apted, M.J. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 10p. (CONF-871124—96). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008178/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Laboratory tests were conducted to validate a radionuclide mass transfer model. During the experiments, cesium and uranium releases from a simulated waste form embedded in an isotropic medium of quartz sand were measured. A 0.01 {und M} NaH_2PO_4 buffer solution flowed past the waste form. Downstream concentrations obtained from computer simulations were compared with experimentally measured concentrations of cesium and uranium. Uranium release was found to be controlled by solubility-limited mass transfer, while cesium releases was controlled by waste form dissolution kinetics. It was also found that the effects of dissolution on groundwater chemistry must be coupled with solubility-limited mass transfer models to defensibly predict radionuclide release rates under realistic repository conditions. 10 refs., 6 figs.

35851 **(PNL-SA—15403) Analysis of congruent matrix release, precipitation, and time-distributed containment failure on spent fuel performance.** Apted, M.J.; Engel, D.W. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 11p. (CONF-871124—95). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008177/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The Analytical Repository Source-Term (AREST) code has been developed for source-term evaluation of spent fuel as a final waste form in geologic repositories. AREST contains a set of analytical equations for the time-dependent diffusional mass transport of both solubility-limited and inventory-limited radionuclides from a spent fuel in a failed container surrounded by a shell of packing or other porous material imbedded in a porous host rock. Three factors that affect release performance are congruent dissolution of the UO_2 matrix: chemical instability of the UO_2 matrix, with precipitation of a more stable uranium phase within the waste package: and the attenuation of release rate by distribution of containment failures with time. For congruent matrix dissolution, the release rates of included nuclides are proportional to the product of solubility-limited release of uranium and the fractional abundance of the nuclide. For certain conditions, congruent release rates are calculated to be up to 10 orders of magnitude lower than release rates assuming individual solubility-limits. Precipitation of a more stable, lower solubility uranium phase within the waste package is shown to in-

crease release rates from the UO_2 matrix compared to the non-precipitation case, in agreement with previous calculations. During the first 300 to 1000 years after repository closure, the distribution of containment failures with time will act to attenuate the peak average release rates of soluble, long-lived nuclides, such as iodine-129, to values smaller than release rates below regulatory limits. 27 refs., 5 figs.

35852 **(PNL-SA—15574) Update on the Hanford waste vitrification plant technical developments.** Scott, J.L.; Wolfe, B.A.; Allen, C.R.; Bates, S.O. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 8p. (CONF-880201—40). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011899/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The US Dept. of Energy (DOE) program to dispose of defense high-level waste is formally described in the Defense Waste Management Plan submitted to Congress in 1983. This plan outlines the strategy of sequencing the disposal efforts at the three DOE sites that have high-level wastes: Savannah River, Hanford Site, and Idaho. Sequencing the effort will enable the Hanford Site to take advantage of the development work and operating experience gained at the Savannah River site.

35853 **(PNL-SA—15579) West Valley glass product qualification durability studies: Effects of composition, redox state, heat treatment, and groundwater.** Reimus, M.A.H.; Piepel, G.F.; Mellinger, G.B. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 21p. (CONF-880354—6). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008201/JAW.

From Waste management '88; Tucson, AZ, USA (1 Mar 1988).

Pacific Northwest Laboratory is examining the effects of composition, ferrous/ferric ratio (redox state), heat treatment, and groundwater on the chemical durability of a glass proposed for solidification of West Valley nuclear waste. Several experiments have been conducted, and preliminary results are given in this paper. The results of the experiments conducted to date indicate that waste glass is more durable in groundwater than in deionized water; also, durability is affected by isothermal and simulated canister cooling heat treatments. However, the durability of the waste glass is not strongly affected by the variation of glass redox state. Linear mixture models were fitted to the glass compositional variation data and validated. These models may be used to predict the effects of varying specific components on the reference glass durability within the defined composition region. 12 refs, 6 figs, 4 tabs.

35854 **(PNL-SA—15631) Recent developments in technology for recovery/purification of selected byproducts.** Bray, L.A.; Jensen, G.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 15p. (CONF-880201—38). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009476/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

For over three decades, US interest in recovery, purification, and application of selected nuclear byproducts (e.g., ^{137}Cs, ^{90}Sr, ^{85}Kr, ^{241}Am, ^{147}Pm, etc.) has remained at a high level. Such interest in byproduct separation and utilization has been sustained even though no irradiated commercial light water reactor fuel, a prime source of such byproducts, has been reprocessed in the US since 1972. This paper briefly reviews and summarizes some recent work at several US Department of Energy (DOE) sites concerning recovery and purification of ^{153}Gd, ^{241}Am, noble metals, and certain other potentially useful and valuable radioactive byproducts.

35855 **(RFP—4212) Development of a trial burn plan for a mixed waste fluidized bed incinerator.** Kabot, F.J.; Ziegler, D.L. (Weston (Roy F.), Inc., Lakewood, CO (USA); Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1988. Contract AC04-76DP03533. 14p. (CONF-880679—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008051/JAW.

From 81. annual meeting of Air Pollution Control Association; Dallas, TX, USA (1 Jun 1988).

One of the more important elements of the incinerator permitting process under RCRA is the development of the Trial Burn Plan. This document describes the incinerator and defines the incinerator's process envelope within which the trial burns will be conducted. The data obtained during the trial burns will be the basis for the incinerator's operating permit. This paper describes the development of the Trial Burn Plan for a unique fluidized bed incinerator to be used for the incineration of hazardous and mixed wastes at the Department of Energy's Rocky Flats Plant. It describes a review process of the Trial Burn Plan involving a public comment period that actually preceded the trial burns. 2 refs., 1 fig.

35856 **(SAND—84-2624) Waste disposal performance assessment using attenuation factors.** Klett, R.D. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011765/JAW.

This report defines the requirements for waste disposal performance assessment (PA) methods in general and discusses specific requirements for subseabed nuclear waste disposal. Processes in waste disposal systems are discussed, concentration on characteristics pertinent to PA. The attenuation factor method of PA is developed based on retardation, pulse spreading, dilution, and dispersion processes. This method computes the reduction of risk potential made by each component of the system. Mathematical models for deterministic and probabilistic analyses along with several examples are given. Uses and limitations of the method are discussed. Although the attenuation factor method of PA was developed for the disposal of nuclear waste, it can be adapted to the disposal of nonnuclear hazardous wastes. 16 refs., 14 figs., 3 tabs.

35857 **(SAND—86-7000) Effective continuum approximation for modeling fluid and heat flow in fractured porous tuff: Nevada Nuclear Waste Storage Investigations Project.** Pruess, K.; Wang, J.S.Y.; Tsang, Y.W. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC04-76DP00789. 100p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010969/JAW.

Fluid and heat flow in ffractured porous media can be great complexity, and a quantitative description requires the development of simplified mathematical and numerical methods. This report presents a detailed formulation, and partial evaluation, of an "effective continuum approximation" for non-isothermal multi-phase flow, which had been introduced previously only in a heuristic fashion. The key concept on which the effective continuum approach must rely is (approximate) local thermodynamic equilibrium between fractures and rock matrix. The applicability of this approximation is discussed and studied by means of numerical simulations for emplacement of high-level waste packages in partially saturated fractured tuff. The simulations demonstrate that the validity of the effective continuum approximation cannot be ascertained in general terms. The approximation will break down for rapid transients in flow systems with low matrix permeability and/or large fracture spacing, so that its applicability needs to be carefully evaluated for the specific processes and conditions under study. The effective continuum approximation has been applied for a preliminary study of fluid and heat flow near a high-level nuclear waste repository on a regional scale, employing a highly simplified strtatigraphic description. It was found that substantial gas phase convection was taking place, with convection velocities being sensitive to permeability, porosity, and tortuosity of the fracture network. 18 refs., 27 figs., 7 tabs.

35858 **(SAND—87-3083) Preliminary seal design evaluation for the Waste Isolation Pilot Plant.** Stormont, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 67p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008976/JAW.

This report presents a preliminary evaluation of design concepts for the eventual sealing of the shafts, drifts, and boreholes at the Waste Isolation Pilot Plant Facility. The purpose of the seal systems is to limit the flow of water into, through, and out of the repository. The principal design strategy involves the consolidation of crushed or granular salt in response to the closure of the excavations in salt. Other candidate seal materials are bentonite, cementi-

tious mixtures, and possibly asphalt. Results from in situ experiments and modeling studies, as well as laboratory materials testing and related industrial experience, are used to develop seal designs for shafts, waste storage panel entryways, non-waste containing drifts, and boreholes. Key elements of the ongoing experimental program are identified. 112 refs., 25 figs., 1 tab.

35859 **(SAND—88-0054C) An analysis of crud contribution to the maximum permissible release rates for reactor spent fuel shipments.** Sandoval, R.P.; Sanders, T.L.; Einziger, R.E.; Malinauskas, A.P.; Mings, W.J. (Sandia National Labs., Albuquerque, NM (USA); Pacific Northwest Lab., Richland, WA (USA); Oak Ridge National Lab., TN (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 8 Jan 1988. Contract AC04-76DP00789. 7p. (CONF-880601—20; TTC—0772). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88005697/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The Office of Civilian Radioactive Waste Management is sponsoring a program to develop standardized methodologies for evaluating spent fuel source terms and demonstrating compliance of spent fuel shipping packages to the federal containment requirements. An important subtask of the program is the evaluation of the neutron-activated corrosion-product deposits (i.e., "crud") on irradiated fuel rod surfaces and the determination of the contribution of these "crud" deposits to the total activity available for release from cask containment. During transportation, crud may spall from the fuel rods, disperse and become suspended in the cavity medium (gas or liquid), and could be the major contributor to the total source term. An analysis of all available data on crud deposit activity concentration distributions, composition, spallation properties, particle size distribution, and crud friability was conducted for various light-water-reactor fuels for selected burnups and decay times. Assuming that crud is the only source of activity release, the maximum permissible leakage rates were estimated using these data for seven types of truck and rail shipping casks containing 1-year-cooled and 10-year-cooled spent fuel. The details and results of this analysis are presented in this paper. 2 refs.

35860 **(SAND—88-0844) Summary report for the WIPP [Waste Isolation Pilot Plant] technology development program for isolation of radioactive waste.** Tyler, L.D.; Matalucci, R.V.; Molecke, M.A.; Munson, D.E.; Nowak, E.J.; Stormont, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 303p. NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88009866/JAW.

The technology experiments have been managed in three broad categories: Thermal/Structural Interactions (TSI), Plugging and Sealing Performance and Design (P&S), and Waste Package Performance (WPP). The history and major progress in each of these areas is summarized in this report. The TSI program has established the fact that the WIPP salt creep rate, and therefore closure of WIPP rooms, is about three times more rapid than our best models predicted prior to the tests. Studies to resolve this discrepancy are well advanced; in the interim, good agreement between predicitions and observation is obtained by empirical adjustment of the elastic constants. The closure of backfilled waste room to about five percent void volume is predicted to take less than 100 years, the time during which active controls may be assumed to prevent human intrusion. The waste package program has revealed that migration of interstitial brine to excavations in the WIPP salt occurs at a significantly greater rate than assumed by earlier investigations. A satisfactory model to explain the data utilizes darcy flow in very low permeability salt which is driven by a pore pressure gradient caused when the excavation creates an atmospheric pressure boundary. This model, coupled with room closure predictions and backfill design using a salt/bentonite clay mixture, indicates that the rate of brine seepage will not result in a fluid or slurry state in the room, but rather in a compacted solid. 373 refs., 20 figs., 9 tabs.

35861 **(SKN—17-Vol.1) Technical and socio-political issues in radioactive waste disposal 1986. Vol. 1. Safety, siting and interim storage.** Parker, F.L.; Kasperson, R.E.; Andersson, T.L.; Parker, S.A. (National Board for Spent Nuclear Fuel, Stockholm (Sweden); Beijer Inst., Stockholm (Sweden)). Nov 1987. 201p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753587/JAW.

The purpose of the study was to provide an integrated technical and socio-political analysis of how six countries (Federal Republic of Germany, France, Sweden, Switzerland, United Kingdom and the United States of America) have responded to four key issues in radioactive waste management: a) What constitutes 'safe' or 'absolutely safe' disposal, b) site selection processes, c) timing and type of interim storage.

35862 **(UCID—21139) Underground research laboratory grout trials: Geotomography results.** Ramirez, A.L.; Daily, W.D. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011758/JAW.

As part of a grouting test at the Atomic Energy of Canada Limited Underground Research Laboratory, Lawrence Livermore National Laboratory conducted an electromagnetic tomography experiment to evaluate the potential of the technique to detect grout invasion. Changes of the electromagnetic attenuation rate of the rock were detected within the highly permeable altered region of a fracture zone after a jet washing-grouting process was completed. The attenuation rate was observed to decrease near grout hole GH1 and increase near grout hole GH2. The quantity of material removed from the fracture zone by jet washing, as well as the quantity of grout accepted by each borehole was different. It is possible that the observed difference in electromagnetic response at the two locations is dependent upon both grout invasion and the amount of infilling material removed by the jet washing process. The spatial distribution of the changes in attenuation rate near GH1 and GH2 correlate well with the location of the highly permeable region on the fracture zone and with locations where jet washing removed fracture infilling material. 9 refs., 4 figs.

35863 **(UCRL—21010) Well development and hydraulic testing at LLNL (Lawrence Livermore National Laboratory) Site 300, Building 830, 834, 840 and GSA areas.** (Weiss Associates, Oakland, CA (USA)). Mar 1988. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009070/JAW.

Well development was conducted on 17 monitor wells in the southeast part of Site 300. Seven wells exhibited some increase in flow or recovery rates, and most wells showed some decrease in water turbidity andor sediment content. Further development of these wells would probably not significantly increase well yields. Hydraulic testing was performed on 19 monitor wells in the southeast part of Site 300. Seventeen of the wells were successfully tested using constant-discharge pumping test or slug tests. Hydraulic conductivity ranged from 0.04 to 94 gpdft^2. Hydraulic conductivity greatly varied with well location and screened depth, which is consistent with the fractured and heterogeneous geologic environment of the Site 300 area. Remediation by ground water extraction does not appear feasible in the perched ground water in the shallow alluvium, conglomerate, and sandstone of the Building 834 area. The wells within the sandstones of the General Services Area suport moderate flow rates and may be suitable for ground water extraction, if necessary. In general, the ability to support extractable flow rates is dependent on the locations and orientations of fractures, which are not presently known. Identifying fractures by surface mapping and exploratory drilling is recommended if ground water extraction is desired. However, identificaion of fracture orientation and spacing may be difficult and costly.

35864 **(UCRL—21044-Vol.3) Waste minimization study for the Lawrence Livermore National Laboratory: Lead.** (Bechtel National, Inc., San Francisco, CA (USA)). 31 Jul 1987. Contract W-7405-ENG-48. 190p. NTIS, PC A09;3. Order Number DE88009073/JAW.

Bechtel National, Inc. contracted with the Lawrence Livermore National Laboratory (LLNL) to provide support for a Waste

Minimization Program. Reports were delivered to the Laboratory at the end of the contract period. The contract was extended to include work to minimize solvent wastes. During this extension period, the Minimization Team was asked to prepare a report officially titled {open←quotes}Lead Integrated Management Program (LIMP){close←quotes} in reply to a request by the Department of Energy. At that time, the decision was reached to provide a Lead Waste Minimization Study in a parallel effort to the LIMP report since the research and data base is common to both. In fact, the LIMP report is attached and is referred to extensively in the course of the Minimization Study. The Lead Study replaces one of the three final solvent reports specified as deliverables under the Contract extension.

35865 **(UCRL—21046) Geotechnical investigation for a Decontamination and Waste Treatment Facility, Lawrence Livermore National Laboratory, Livermore, California.** (Lawrence Livermore National Lab., CA (USA); Bechtel National, Inc., San Francisco, CA (USA)). Jul 1986. Contract W-7405-ENG-48. 95p. NTIS, PC A05;3. Order Number DE88011319/JAW.

This report presents the results of the geotechnical investigation performed for a proposed Decontamination and Waste Treatment Facility (DWTF) at the Lawrence Livermore National Laboratory (LLNL) in Livermore, California. The site is located in the northeast corner of the LLNL complex. The purpose of the study was to investigate the subsurface conditions and evaluate the suitable foundation types for the proposed construction. This report presents a description of the soil and ground water conditions encountered during the field exploration; an analysis and evaluation of the laboratory test data obtained; and the recommendations for the design and construction of foundations for the proposed structures. The drilling and laboratory testing were performed, respectively, by LLNL subcontractors, Pitcher Drilling and Berlogar Geotechnical Consultants. 6 refs.

35866 **(UCRL—97450) Tritium storage in ion-exchanged zeolites.** Maienschein, J.L.; McMurphy, F.E.; Uribe, F.S. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 23p. (CONF-880505—26). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011314/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Cesium-exchanged Type 4A zeolites can encapsulate high-pressure tritium by physical entrapment in interior pores. We present data on storage capacity related to physical pore volume in the zeolite, and show that storage stability is reasonably good for short periods. Our data also shows that the zeolite releases helium while retaining tritium. Results are analyzed in terms of a diffusion model in the literature. The zeolite showed no structural change after a radiation dose of 10^8Gy; it is unclear if radiation affects storage stability. 22 refs., 4 figs., 2 tabs.

35867 **(USGS/MAP/I—1826) Surficial geologic map of the Bare Mountain quadrangle, Nye County, Nevada.** Swadley, W.C.; Parrish, L.D. (Geological Survey, Denver, CO (USA)). 1988. Contract AI08-78ET44802. 13p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. Order Number TI88010248/JAW.

35868 **(WHC-SA—0183) Radionuclide release behavior of light water reactor spent fuel under hydrothermal conditions.** Neal, W.L.; Rawson, S.A.; Murphy, W.M. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1987. Contract AC06-87RL10930. 13p. (CONF-871124—102). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011949/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The Basalt Waste Isolation Project has performed initial characterization of the release behavior of radionuclides from ATM-101 spent fuel reacted under hydrothermal conditions. Results to date indicate that (1) ^{14}C, ^{90}Sr, ^{129}I, and ^{137}Cs exhibit preferential release to solution relative to the actinides, (2) /sup 239+240/Pu, ^{241}Am, and ^{244}Cm ratios in solution are consistent with stoichiometric dissolution of the spent fuel matrix, whereas uranium concentrations are higher than those predicted for stoichiometric dissolution, (3) ^{137}Cs release varies as a function of the fluid to solid mass ratio, and (4) ^{14}C, ^{129}I, and ^{137}Cs release is affected by fuel particle size and/or fuel washing.

35869 **Treatment and disposal of tritium containing waste at Mound.** Rogers, M.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound Facility). *Fusion Engineering and Design;* **5**: No. 4, 415-419(Jan 1988). Contract AC04-76DP00053.

First generation fusion machines will burn the hydrogen isotopes deuterium and tritium as fuel. Tritium, which is radioactive, must be handled carefully and any byproducts must be disposed of as radioactive waste. Tritiated waste will fall into one of three categories: gaseous, liquid, or solid. Sources and expected quantities of tritiated waste that are likely to be generated by a fusion machine will be discussed. Strategies, options and processes for dealing with tritium containing wastes will also be presented. Final disposition of each category of tritium contaminated waste is governed by regulations and guidelines. These regulations and guidelines, and how they might apply to a fusion reactor facility, will be outlined.

35870 **The formation of surface layers and reaction products in the leaching of defense borosilicate nuclear waste glass.** Harker, A.B.; Flintoff, J.F. (Rockwell International Science Center, 1049 Camino Dos Rios, P.O. Box 1085, Thousand Oaks, CA (US)). *Nuclear Technology;* **76**: No. 2, 263-278(Feb 1987).

The development of surface alteration layers and solid products in the reaction of borosilicate nuclear waste glass with aqueous solutions has been studied as a function of time, surface morphology, water flow rates, and solution composition. A physical description of the growth of the surface layers has been developed, and several solid reaction products have been identified. The results of the study support a saturation based description of long-term radionuclide release from glass waste forms and demonstrate the complex dependence of short-term leaching experiments upon both surface and solution variables.

35871 **Statistical process control: An approach to quality assurance in the production of vitrified nuclear waste.** Pulsipher, B.A.; Kuhn, W.L. (Pacific Northwest Lab., Richland, WA 99352 (US)). pp 483-488 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC06-76RL01830.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Current planning for liquid high-level nuclear wastes existing in the United States includes processing in a liquid-fed ceramic melter to incorporate it into a high-quality glass, and placement in a deep geologic repository. The nuclear waste vitrification process requires assurance of a quality product with little or no final inspection. Statistical process control (SPC) is a quantitative approach to one quality assurance aspect of vitrified nuclear waste. This method for monitoring and controlling a process in the presence of uncertainties provides a statistical basis for decisions concerning product quality improvement. Statistical process control is shown to be a feasible and beneficial tool to help the waste glass producers demonstrate that the vitrification process can be controlled sufficiently to produce an acceptable product. This quantitative aspect of quality assurance could be an effective means of establishing confidence in the claims to a quality product.

35872 **Hydrogen absorption and crevice corrosion behavior of Ti Grade 12 during exposure to irradiated brine at 150°C.** Westerman, R.E.; Telander, M.R. (Pacific Northwest Lab., Richland, WA 99352 (US)). pp 463-470 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC06-76RL01830.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Ti Grade 12 alloy is being considered for use as a corrosion-resistant overpack for high-level nuclear waste packages in a salt repository. Two experiments performed at Pacific Northwest Laboratory (PNL) were directed toward determining this material's resistance to hydrogen absorption and crevice corrosion during exposure to concentrated anoxic NaMgK chloride brines at 150°C under conditions of gamma irradiation. At an irradiation intensity of 2 x 10^4 radhr, the hydrogen absorption rate of Ti Grade 12 specimens was low, and appeared to stop entirely after six months. Grit-blasted specimens absorbed considerably more hydrogen than as-received sheet stock specimens. Crevice corrosion was observed between specimen spacers and between (purposefully) contacting specimens. The observed crevice corrosion susceptibility must be taken into account when considering the Ti Grade 12 alloy as a candidate waste package overpack material.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 35734, 35750, 35751, 35758, 35759, 35762, 35765, 35768, 35769, 35770, 35772, 35773, 35776, 35780, 35783, 35787, 35790, 35791, 35799, 35817, 35821, 35822, 35823, 35824, 35826, 35827, 35828, 35834, 35836, 35839, 35842, 35843, 35846, 35847, 35848, 35850, 35851, 35853, 35855, 35858, 35859, 35860, 35862, 35863, 35864, 35876, 35877, 35878, 35880, 35881, 37713, 37720, 37766, 37774, 37838, 37853, 37854, 38019

35873 **(IAEA-SM—303/134) Overview of mixed waste issues at the Department of Energy defense installations.** Mezga, L.J.; Eisenhower, B.M. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 18p. (CONF-880510—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010141/JAW.

From International symposium on the management of low and intermediate level radioactive wastes; Stockholm, Sweden (16 May 1988).

Due to the {open+-quotes}double hazard{close+-quotes} associated with these waste materials, the ability to manage these mixed wastes has been somewhat limited. The unavailability of acceptable and proven treatment and/or disposal systems has forced the Department of Energy (DOE) installations to place these materials in storage. The limited capacity of permitted storage areas and the desire to move forward in the overall waste management cycle have placed an increased emphasis on the need to develop treatment/disposal technologies for mixed wastes. Programs have been initiated by contractors who operate the DOE installations to provide the technical basis for selecting technologies to render these wastes nonhazardous through treatment by destroying the hazardous constituent, to separate the hazardous constituents from the radioactive constituents, to treat the wastes and place them in a form that will meet EPA requirements to be classified as nonhazardous, and to provide facilities for the disposal of wastes which cannot be changed into a nonhazardous form. These wastes include a variety of materials such as chlorinated solvents and waste oils contaminated with uranium or fission products, liquid scintillation wastes, and sludges from wastewater treatment plants contaminated with uranium or fission products. By volume, the largest mixed waste streams are the contaminated wastewater treatment sludges. Plans for the management of the major categories of mixed waste are presented below. More detailed information on plans for specific waste streams is presented in the paper.

35874 **(WINCO—1052) ICPP [Idaho Chemical Processing Plant] environmental monitoring report, CY-1986.** Krivanek, K.R. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Feb 1988. Contract AC07-84ID12435. 43p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009029/JAW.

Summarized in this report are the data collected through Environmental Monitoring programs conducted at the Idaho Chemical Processing Plant (ICPP) by the Environmental Engineering (EE) subsection of the Nuclear and Industrial Safety (N{ampersand}IS) Department. The EE Subsection completed a Quality Assurance Plan for Environmental Monitoring activities during the third quarter of 1986. Implementation of the Quality Assurance Plan has resulted in the implementation of the Environmental Protection Agency rules and guidelines pertaining to the collection, analyses, and reporting of environmentally related samples. Where no approved laboratory methods for analyses existed for radionuclides, currently used methods were submitted for the EPA approval. Tables summarize the volumes and radioactivity of effluents released from ICPP stacks and liquid release points. Figures provide graphic representation of cummulative airborne releases and depict cumulative liquid releases for the year. Graphs allow a comparison to be made of waste volume and activity released for the year. During 1986 6.93 E + 03 curies of activity were released from airborne and liquid emission points at the ICPP operations. Airborne releases to the atmosphere contributed 6.07 E + 01 curies and liquid effluent released to the Percolation Pond contributed 2.52 E + 02 curies. 23 figs., 14 tabs.

0540 Health And Safety

REFER ALSO TO CITATION(S) 35744, 35765, 35766, 35770, 35773, 35864, 35885, 36577, 37991, 37996, 38019

35875 **(DOE/ID/12584—22) Radiologic characterization of the Weldon Spring, Missouri, Remedial Action Site.** Marutzky, S.J.; Colby, R.; Cahn, L.S. (UNC Technical Services, Inc., Grand Junction, CO (USA)). Feb 1988. Contract AC07-86ID12584. 234p. (UNC/GJ-HMWP—4). NTIS, PC A11;1. Order Number TI88010901/JAW.

The US Department of Energy established the Weldon Spring Site Remedial Action Program in February 1985 to effect remedial action at the Weldon Spring Chemical Plant site and the Femme Osage Slough Vicinty Property. This radiologic characterization of the Weldon Spring Site was performed at the request of the DOE/Oak Ridge National Laboratory, Weldon Spring, because additional data were needed to complete the Environmental Impact Statement in compliance with the National Environmental Policy Act and because no broad data collection effort of radiologic contamination in the Chemical Plant area had been performed. The field work was conducted by UNC Geotech, operating contractor for the DOE/Grand Junction Projects Office, during the period April through July 1987. This report includes descriptions of the in-situ measurement methods, data reduction, sampling techniques, and sample analytical methods; and data summaries. The report is not meant to serve as an analysis of the information derived from the conduct of this characterization effort, but rather as a presentation of the scope of the field activity, the measurement methods, and a compendium of the sample results. 9 figs., 18 tabs.

35876 **(DOE/ID/12584—27) Environmental monitoring report on the US Department of Energy's inactive millsite facility, Monticello, Utah, for calendar year 1987.** (UNC Geotech, Grand Junction, CO (USA)). May 1988. Contract AC07-86ID12584. 36p. (UNC/GJ-HMWP—6). NTIS, PC A03;3. Order Number DE88011470/JAW.

The inactive Monticello Millsite is located in San Juan County, Utah, just south of the town of Monticello. Environmental monitoring at the site is funded by the Surplus Facilities Management Program (SFMP) and focuses on releases due to preexistent mill tailings. All contaminant discharges result from the leaching of uranium-mill-tailings-related elements by ground water and surface water, and from the release of radon gas and particulate matter into the atmosphere. Pathways facilitating the migration of contaminants from the Monticello site include ground water in the shallow alluvial aquifer underlying the inactive facility, surface water running across the site, and the surrounding atmosphere. Extensive measurement of radon contamination from the tailings piles was conducted during 1984, 1985, and to a lesser extent during 1986 and 1987. On-pile, site-boundary, and off-site atmospheric radon measurements, as well as on- and off-pile radon-flux measurements, were taken. Results of these measurements demonstrate that the EPA standard for radon emissions from inactive uranium processing sites is exceeded at all four tailings piles at the Monticello site. Air particulate monitoring was conducted during 1987 at two on-site locations and at one background location using high-volume Sierra-Anderson model 300 air particulate samplers. So that only the inhalable particles would be collected, 10-micron-size screens were added to the samplers. The maximum airborne concentrations of radium-226, thorium-230, and uranium were all several orders of magnitude below

the regulatory limits specified by DOE Order 5480.1. 22 refs., 5 figs., 9 tabs.

35877 (DOE/OR/00033—T405) A critical essay: Ten mile emergency planning zones, pro or con. MacDurmon, G.W. (Rutgers--the State Univ., New Brunswick, NJ (USA)). Dec 1987. Contract AC05-76OR00033. 44p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009042/JAW.

The NRC's current emergency planning regulations are based on source term data which has come into question. Indeed, many current models indicate that source terms can be calculated which are one or more orders of magnitude lower than those from WASH-1400. However, there remains a number of unresolved technical issues between the NRC and the Industry Downgraded Core Research Program (IDCOR) calculated source terms which presents a very large uncertainty for the determined values. In addition, there remains questions concerning the integrity of containment, and the emphasis which should be placed on operator intervention. These results have caused both the NRC and the APS to state that source terms cannot be lowered for all radionuclides and all nuclear power plants at this time. Data from NUREG-1150, along with the statements of other experts, do seem to demonstrate that evacuation, as a means of dose minimization, has been overemphasized under the current regulations. While an appropriate evacuation planning distance, specific to each plant, would vary according to a number of factors such as population density, available transportation, typical housing structures for shelter, type of plant containment, etc., current methods of emergency planning must also address these issues. In light of this and the dose estimates across the Emergency Planning Zone (EPZ), it would seem that detailed emergency plans out to ten miles which place an emphasis on evacuation are unnecessary from a health physics perspective, and bear heavy socioeconomic costs. 14 refs., 13 figs., 5 tabs.

35878 (DPST—86-204) Onsite radiation doses from postulated reactor accidents. Price, J. B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1986. Contract AC09-76SR00001. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011675/JAW.

This report documents a study of the onsite dose from postulated reactor accidents. Radiation doses are calculated to the level of detail previously used for offsite dose estimates. The study includes the major accident scenarios that are analyzed in the Safety Analysis Report for SRP production reactors for wind speed and direction, topography, and release height appropiate to the SRP site. All exposures outside the reactor building assume personnel are outdoors and unshielded. 3 refs., 1 fig., 6 tabs.

35879 (INFO—0138) Derived surface contamination limits for the uranium mining and milling industry. Ching, S.H. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Oct 1984. 33p. (CONF-841016—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701919/JAW.

From International conference on occupational radiation safety in mining; Toronto, Ontario, Canada (15 Oct 1984).

Derived Surface Contamination Limits (DSCL) are proposed for the control of surface contamination at the work place for the uranium mining and milling industry. They have been derived by a method incorporating recent ICRP recommendations and consideration of the radiation exposure pathways of ingestion, inhalation and external irradiation of the basal layer of skin. A generalized DSCL of 10^5 Bqm^3 of beta activity is recommended for all contaminants likely to be found in uranium mine and mill workplaces except for fresh uranium concentrates. In the latter case, the DSCL is expressed in terms of alpha activity because the ratio of beta to alpha activities for fresh uranium concentrates is variable; the beta activity increases with the ingrowth of U-238 daughter products (Th-234 and Pa-234m) until secular equilibrium is re-established in about six months. A surface contamination limit of 10^4 Bqm^3 of beta activity is proposed for the release of non-porous materials and equipment with no detectable loose contamination to the public domain.

35880 (PNL-SA—15020) Analysis of radiation doses for a transportation system and its interface operations for commercial spent fuel. Schneider, K.J.; Ross, W.A.; Smith, R.I.; Wilmot, E.L. (Pacific Northwest Lab., Richland, WA (USA); USDOE, Washington, DC). Jul 1987. Contract AC06-76RL01830. 7p. (CONF-871102—4). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009484/JAW.

From International waste management conference; Kowloon, China (29 Nov 1987).

This paper gives the results of estimates of aggregated radiation doses to the affected public and workers in the US that would be associated with loading spent fuel at the reactors, transporting the spent fuel by truck and rail, and receiving and unloading the spent fuel at a deep geological repository. The estimates are for a postulated transportation-related system using current state-of-the-art technology, if employed in the high-level waste management system in the future, and the approximate dose reduction from some potential system improvements. The results of the study provide a starting point for the US Department of Energy (DOE) to develop an improved transportation system that is cost effective, safe, and results in low radiation doses. 4 refs., 1 figs., 5 tabs.

35881 (UCRL—98435) The atmospheric release advisory capability (ARAC): A federal emergency response capability. Dickerson, M.H.; Sullivan, T.J. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 16p. (CONF-880679—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011348/JAW.

From 81. annual meeting of Air Pollution Control Association; Dallas, TX, USA (1 Jun 1988).

The Atmospheric Release Capability (ARAC) is a Department of Energy (DOE)-sponsored emergency-response service set up to provide real-time prediction of the dose levels and the extent of surface contamination resulting from a broad range of possible occurrences (accidents, spills, extortion threats involving nuclear material, reentry of nuclear-powered satellites, and atmospheric nuclear tests) that could involve the release of airborne radioactive material. During the past decade, ARAC has responded to more than 150 real-time situations, including exercises. The most notable responses include the Three Mile Island accident in Pennsylvania, the Titan II missile accident in Arkansas, the reentry of the USSR's COSMOS-954 into the atmosphere over Canada, the accidental release of uranium hexafluoride from the Sequoyah Facility accident in Oklahoma, and, most recently, the Chernobyl reactor accident in the Soviet Union. ARAC currently supports the emergency-preparedness plans at 50 Department of Defense (DOD) and DOE sites within the US and also responds to accidents that happen elsewhere. Our ARAC center serves as the focal point for data acquisition, data analysis and assessments during a response, using a computer-based communication network to acquire real-time weather data from the accident site and the surrounding region, as well as pertinent accident information. Its three-dimensional computer models for atmospheric dispersion, MATHEW and ADPIC, digest all this information and produce the predictions used in accident assessment. 9 refs., 6 figs., 1 tab.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 35898, 36504, 36505, 38959

35982 (AAEC/E—657) Video imaging system and related control hardware for nuclear safeguards surveillance applications. Whichello, J.V. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702835/JAW.

A novel video surveillance system has been developed for safeguards applications in nuclear installations. The hardware was tested at a small experimental enrichment facility located at the Lucas Heights Research Laboratories. The system uses digital video techniques to store, encode and transmit still television pictures over the public telephone network to a receiver located in the Australian Safeguards Office at Kings Cross, Sydney. A decoded, reconstructed picture is then obtained using a second video frame store. A computer-controlled video cassette recorder is used auto-

matically to archive the surveillance pictures. The design of the surveillance system is described with examples of its operation.

35883 **(BNL—41120) An overview of holdup measurement technology.** Zucker, M.S. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 17p. (CONF-880352—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008812/JAW.

From INMM workshop on process holdup; Rockville, MD, USA (2 Mar 1988).

The origin of holdup, where it occurs in plants, and the methods of assay thus far found useful under conditions often found in nuclear fuel manufacturing installations are discussed.

35884 **(DP-MS—87-148) Statistical estimation of process holdup.** Harris, S.P. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 49p. (CONF-880352—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006664/JAW.

From INMM workshop on process holdup; Rockville, MD, USA (2 Mar 1988).

Estimates of potential process holdup and their random and systematic error variances are derived to improve the inventory difference (ID) estimate and its associated measure of uncertainty for a new process at the Savannah River Plant. Since the process is in a start-up phase, data have not yet accumulated for statistical modelling. The material produced in the facility will be a very pure, highly enriched 235U with very small isotopic variability. Therefore, data published in LANL's unclassified report on Estimation Methods for Process Holdup of a Special Nuclear Materials was used as a starting point for the modelling process. LANL's data were gathered through a series of designed measurements of special nuclear material (SNM) holdup at two of their materials-processing facilities. Also, they had taken steps to improve the quality of data through controlled, larger scale, experiments outside of LANL at highly enriched uranium processing facilities. The data they have accumulated are on an equipment component basis. Our modelling has been restricted to the wet chemistry area. We have developed predictive models for each of our process components based on the LANL data. 43 figs.

35885 **(LA—11120-PR) Safeguards and security: Progress report, January-December 1986.** Smith, D.B. (comp.). (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 120p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88010473/JAW.

From January to December 1986, the Los Alamos Safeguards and Security Program was involved in the activities described in the first four parts of this report: Nuclear Facility Support, Security Development and Support, Technology Development, and International Support. Part 1 covers efforts of direct assistance to the Department of Energy (DOE) and includes consultation on materials accounting problems, development and demonstration of specialized techniques and instruments, and comprehensive participation in the design and evaluation of advanced safeguards systems. Part 2 treats activities aimed at the security of computer systems. Our focus was on continuing the activities of the Center for Computer Security, which provides the basis for encouraging and disseminating this emerging technology, and on the development and demonstration of secure computer systems. Part 3 describes the broad development efforts essential to continuing improvements in the practice of safeguards. Part 4 covers international safeguards activities, including both support to the International Atomic Energy Agency (IAEA) and bilateral exchanges. Activities that have other sponsors are reported in Part 5. The final part lists titles and abstracts of Los Alamos safeguards R and D reports, technical journal articles, and conference papers that were published in 1986. 97 refs., 70 figs., 16 tabs.

35886 **(LA—11229-MS) A new method of calibration and normalization for neutron detector families.** Menlove, H.O.; Stewart, J.E. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 52p. (ISPO—287). NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010477/JAW.

A calibration and cross-reference is presented for passive and active neutron assay instruments. The method reduces and number of physical standards required to calibrate families of neutron detectors and also ties together much of the calibration information currently available. The basic approach is to carefully calibrate one member of the family (reference detector) over the complete mass range of interest. Other members of the family can be cross-referenced to the calibrated detector using a single sample or radioactive source. Calibration and cross-reference information is presented for the Inventory Sample Counter, High-Level Neutron Coincidence Counter. Active Well Coincidence Counter, and the Neutron Collar. 1 ref., 15 figs., 20 tabs.

35887 **(LA—11340-MS) Neutron multiplicity measurements during LINAC interrogation of safeguards accountable material.** Brunson, G.S.; Coop, K.L. (Los Alamos National Lab., NM (USA)). Jul 1988. Contract W-7405-ENG-36. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012175/JAW.

The authors used a LINAC to interrogate some arbitrary sample arrays to learn if enriched uranium can be detected when it is embedded in depleted uranium and ^{6}LiD. Whether the interrogation is by bremsstrahlung or photoneutrons, the interrogating pulse causes fission in any uranium present, leaving delayed neutron precursors embedded wherever fissions have occurred. In the interval between LINAC pulses, we detected neutron multiplicities arising from ^{238}U fissions caused by delayed neutrons. Because almost all delayed neutrons have energies below the fission threshold of ^{238}U, a negligible number of fissions occur if ^{235}U is not present in quantity. We are able to detect a 1-kg cylinder of enriched uranium metal behind ~ 2.3 cm of depleted uranium metal and ~ 2.9 cm of ^{6}LiD. For this configuration, the threshold for detecting ^{235}U is ~ 1/3 kg. The results are sensitive to the shape of the uranium sample.

35888 **(LA-UR—88-1077) Methods and techniques of NDA (nondestructive assay).** Reilly, T.D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 41p. (CONF-8804109—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009145/JAW.

From Regional training course on state systems of accounting for and control of nuclear materials; Rio de Janeiro, Brazil (11 Apr 1988).

Nondestructive assay (NDA) refers to techniques and instruments developed to measure nuclear materials in the many forms in which they occur throughout the fuel cycle. These techniques were first developed to support nuclear safeguards inspections and nuclear material accountability; they are also used extensively for process and quality control. Most accountability measurements are based on analytical chemistry and require that a sample be drawn and analyzed destructively. Destructive analysis can not be applied to many of the product materials found in the fuel cycle, such as fuel rods and assemblies, because of their high monetary value. Also, many waste and scrap materials can not be adequately sampled for destructive analysis because of their heterogenous nature. This situation led to the development of nondestructive analysis techniques. This paper presents an overview of the major NDA techniques and instrumentation in use today. The instrumentation described below is now used frequently by safeguards inspectors and facility operators alike. 19 refs., 18 figs., 4 tabs.

35889 **(NBL—318) [New Brunswick Laboratory]: Progress report for the period October 1986 through September 1987.** (USDOE New Brunswick Lab., Argonne, IL). Mar 1988. 82p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88009104/JAW.

This report summarizes the mission activities of the New Brunswick Laboratory (NBL) of the US Department of Energy (DOE). NBL's mission is to provide and maintain a nuclear material measurements and standards laboratory as a technical response to DOE's statutory responsibility to assure the safeguarding of nuclear materials.

35890 **(ORNL/TM—10814) An independent technique for fissile inventory verification of holding tanks in the nuclear fuel cycle status report.** Carter, J.A.; Smith, D.H.; Walker, R.L.; May, M.P. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010765/JAW.

A technique for determination of the liquid volumes of solutions in holding tanks and for their fissile material content has been developed and tested. It is independent of the size of the tank, the fraction of full capacity occupied, and void volumes caused, for example, by build up of solid deposits or gas bubbles. Because the amount of spike added to the tank is accurately known, the inventory is also independent of solution volume and density. It involves use of isotope dilution mass spectrometry through application of a double spiking technique using lutetium. A known amount of natural lutetium is added to the subject tank. After thorough mixing, an aliquot of solution is withdrawn from the tank. A known amount of lutetium enriched in the 176 isotope is added to the aliquot. Mass spectrometric analysis and the technique of isotope dilution allow determination of the volume of liquid in the tank. The same aliquot used for volume determination can be used for assay of uraniuim and plutonium for both isotopic composition and concentration. This allows determination of total fissile weight contained in a given tank. 6 refs., 2 figs., 4 tabs.

35891 **(RFP—4200) Nuclear materials management overview.** DiGiallonardo, D.A. (Rockwell International Corp., Golden, CO (USA). Energy Systems Group). 1988. Contract AC04-76DP03533. 7p. (CONF-880631—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010899/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The true goal of Nuclear Materials Management (NMM) is the strategical and economical management of all nuclear materials. Nuclear Materials Management's role involves near-term and long-term planning, reporting, forecasting, and reviewing of inventories. This function is administrative in nature. It is a growing area in need of future definition, direction, and development. Improvements are required in program structure, the way residues and wastes are determined, how {open«-quotes}What is and what if{close«-quotes} questions are handled, and in overall decision-making methods. 2 refs.

35892 **(SAND—87-1642/i) An adaptable modular Safeguards Control and Communications System (SCCS) overview of the control and display subsystem.** Ortiz, S. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 58p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011275/JAW.

The Control and Display Subsystem is the functional heart of the Safeguards Control and Communications System (SCCS). This document provides an overview of the hardware, software, design features, and operating principles of the subsystem; the functional relationships between the subsystem and other SCCS subsystems are also discussed. Complete references are provided to vendors' literature and separate dedicated documents on various components of the subsystem. 4 figs., 6 tabs.

35893 **(SAND—87-1642/iii) An adaptable modular Safeguards Control and Communications System (SCCS) operator's manual.** Ortiz, S. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 104p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010970/JAW.

This document provides detailed operating instructions for the Safeguards Control and Communications System (SCCS). The SCCS is an automated electronics surveillance system that uses electrical sensors and a closed-circuit television (CCTV) system to enable a central security operator to monitor site security. In order to provide a basis for the operating instructions that follow, the manual begins with a description of the system hardware, concentrating on the hardware at the SCCS operator's console. The manual then provides detailed operating instructions for both normal and emergency operating conditions. 8 figs., 2 tabs.

35894 **(SAND—88-0290C) High bandwidth real time frequency modulated (FM) video link for security and tactical applications.** Lupinetti, F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880631—8). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011484/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

With the increasing demand for in situ unmanned reconnaissance, security control, and intrusion detection, the capability of transmitting and receiving video information from remote locations has become of paramount importance. This capability can be achieved by appropriately deploying radio frequency (RF) video links which can readily be interfaced with sensors, humans, or other RF links. The video link described in this paper was designed and implemented for security and tactical applications which require a medium power, low complexity, rugged link capable of direct transmission and reception of FM modulated, high quality, full-color video signals in the low portion (470–806 MHz) of the UHF frequency band (300–3000 MHz). The transmitter portion of the link is tunable. It is of the direct modulation (FM and FR simultaneously) type. The receiver is of the direct detection type with no need for any downconversion. Both transmitter and receiver are currently being tested for mobile and fixed applications at the Sandia Robotic Vehicle Range. Ranges in excess of 10 Km and simultaneous transmission and reception of three adjacent channels have been achieved using omnidirectional antennas. 6 refs., 13 figs.

35895 **(SAND—88-1675C) Neutralization and system effectiveness.** Paulus, W.K. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 21p. (CONF-880631—10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011916/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Security forces that can neutralize an attack force are essential to effectively safeguard special nuclear material (SNM) against theft or sabotage. Probability of neutralization, P(N), estimates the likelihood that security forces will win given that security forces interrupt the attackers and begin an armed engagement. Brief Adversary Threat Loss Estimator (BATLE) calculates P(N). BATLE was developed for the Nuclear Regulatory Commission in 1980. This paper describes a total repackaging of BATLE which will be called the Threat Neutralization Model. New features and capabilities are (1) guidance to the user in setting up the input parameters, (2) faster software, (3) graphical output and sensitivity curves to assist the user in interpreting the results, (4) compatibility with the SAVI vulnerability analysis program, and (5) operation under Microsoft Windows on personal computers.

35896 **(UCRL—97740) Evaluating late detection capability against diverse insider adversaries.** Sicherman, A. (Lawrence Livermore National Lab., CA (USA)). 3 Dec 1987. Contract W-7405-ENG-48. 7p. (CONF-8711108—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008678/JAW.

From American Nuclear Society topical conference; San Diego, CA, USA (29 Nov 1987).

This paper describes a model for evaluating the late (after-the-fact) detection capability of material control and accountability (MC&A) systems against insider theft or diversion of special nuclear material. Potential insider cover-up strategies to defeat activities providing detection (e.g., inventories) are addressed by the model in a tractable manner. For each potential adversary and detection activity, two probabilities are assessed and used to fit the model. The model then computes the probability of detection for activities occurring periodically over time. The model provides insight into MC&A effectiveness and helps identify areas for safeguards improvement. 4 refs., 4 tabs.

35897 **(UCRL—97741) Safeguards effectiveness evaluations in safeguards planning.** Al-Ayat, R.A. (Lawrence Livermore National Lab., CA (USA)). 3 Dec 1987. Contract W-7405-ENG-48. 5p. (CONF-8711108—4). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008677/JAW.

From American Nuclear Society topical conference; San Diego, CA, USA (29 Nov 1987).

This paper describes analytic tools we developed to quantify the effectiveness of safeguards against theft of special nuclear material by insiders. These tools help identify vulnerabilities in existing safeguards, suggest potential improvements, and help assess the benefits of these upgrades prior to implementation. Alone, these tools are not sufficient for safeguards planning, since the cost of implementing all suggested upgrades almost always exceeds the available resources. This paper describes another tool we developed to allow comparsion of benefits of various upgrades to identify those upgrade packages that achieve the greatest improvement in protection for a given cost and to provide a priority ranking among cost-effective packages, thereby helping decision-makers select the upgrades to implement and highlight the mount of residual risk. 5 refs., 3 figs.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 35766, 35803, 35842

35898 (INIS-mf—11153, pp 35-40) **4. Accounting of nuclear materials.** Lukavsky, J. 1987. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780081/JAW.

In Nuclear power. CAEC lecturers' manual.

The questions are discussed of international policy significance of nuclear materials control and the ensuing position of IAEA. Attention is primarily paid to the Non-proliferation Treaty and to the international safeguards system based on agreements of safeguards among the individual countries and IAEA. In compliance with these agreements, around 600 nuclear installations are currently under control of IAEA. In the CSSR, a state system of nuclear materials record and management was established which fully meets the IAEA requirements while observing the internal regulations of the CSSR. CSKAE (Czechoslovak Atomic Energy Commission) was entrusted with the control of the state system and thus with the performance of state surveillance over the nuclear materials record and management. IAEA has been carrying out inspections of nuclear materials at Czechoslovak work places since 1972. No anomalies have been detected which would indicate possible misuse of nuclear materials. (Z.M.).

35899 (PNL—3594-Rev.8) **International nuclear fuel cycle fact book.** Leigh, I.W. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 247p. NTIS, PC A11;3. Order Number DE88010329/JAW.

As the US Department of Energy (DOE) and DOE contractors have become increasingly involved with other nations in nuclear fuel cycle and waste management cooperative activities, a need has developed for a ready source or information concerning foreign fuel cycle programs, facilities, and personnel. This Fact Book was compiled to meet that need. The information contained has been obtained from nuclear trade journals and newsletters; reports of foreign visits and visitors; CEC, IAEA, and OECD/NEA activities reports; proceedings of conferences and workshops; and so forth. Sources do not agree completely with each other, and the data listed herein does not reflect any one single source but frequently is consolidation/combination of information. Lack of space as well as the intent and purpose of the Fact Book limit the given information to that pertaining to the Nuclear Fuel Cycle and to data considered of primary interest or most helpful to the majority of users.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 36877

35900 (DPST—88-499) **In-bed measurement of tritium loading in process metal hydride beds.** Nobile, A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1988. Contract AC09-76SR00001. 17p. (CONF-8804146—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011667/JAW.

From Storage science meeting; Los Alamos, NM, USA (4 Apr 1988).

The Replacement Tritium Facility at Savannah River Plant will make extensive use of metal hydride technology for the storage, pumping, isotopic separation, and compression of hydrogen isotopes. Two options were considered for routine accountability of tritium stored in metal hydride beds. One option was to use standard P-V-T-mass spectrometry techniques after desorption of storage beds to tanks of known volume. The second option was to develop a technique for direct measurement of bed loading. It was thought that such a technique would be more rapid and would account for heel, although some accuracy would be lost.The static nitrogen and flowing nitrogen methods were considered for this option. The flowing nitrogen method was eventually selected because it was insensitive to bed physical properties and isotopic gas composition, as well as being more accurate and easier to automate.

35901 (LA-tr—88-4) **Survey report: Stable isotope separation.** Bakhtadze, A.B. (Los Alamos National Lab., NM (USA)). 1988. Translated from Stable isotopes in the Life Sciences, International Atomic Energy Agency, Vienna, Austria, 1977, pp. 3-20. 19p. NTIS, PC A03/MF AMF A01.

Proceedings of a Technical Committee Meeting on Modern Trends in the Biological Applications of Stable Isotopes, Leipzig, Germany, 14-18 February, 1977.

The present state of development of methods of separating stable isotopes of light elements (C, N, O, S) is analyzed in the review, together with a discussion of the production of carbon, nitrogen and oxygen highly enriched in ^{13}C, ^{15}N and ^{18}O respectively and of nitrogen depleted of ^{15}N. Features and technical-economic characteristics of such technological processes of isotope production as chemical exchange and cryogenic distillation, which presently are in the widest practical use on an industrial scale, are discussed. Some problems of increasing the capacity of these processes in order to further increase the production of stable isotopes and make them much cheaper, as well as various aspects of stable isotope separation by selective excitation of atoms and molecules by laser beams and in electric discharges, are discussed. 86 refs., 1 tab.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 36889

35902 (GKSS—86/E/68) **Neutron radiography facility in a storage pond of a nuclear power station equipped with antimony-beryllium neutron source.** Greim, L.; Borchers, F.; Greim, M.; Schumacher, G.W.; Schmitz, H.W.; Rudholzer, G. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Bayernwerk A.G., Muenchen (Germany, F.R.)). 1986. 10p. (CONF-8606235—). Reprint from: Barton, J.P.; Farny, G.; Person, J.L.; Roettger, H. (eds.): Neutron radiography. Proceedings of the 2. world conference. Dordrecht: Reidel (1986) p. 367-374.

From 2. world conference on neutron radiography; Paris, France (16 Jun 1986).

A neutron radiography facility is described, which has been installed in the storage pond of the Isar 1 near Munich (KKI). The facility is designed for the inspection of BWR control elements.

Some of the control elements contain the neutron absorbing material boron carbide, filled in tubes. Neutron radiography can be applied to detect absorber losses by nondestructive testing. The design of the facility corresponds to the principle of the diving bell. A tube, with the upper side closed, is submerged at the edge of the pond and the water is pressed out by air. The set up contains an antimony-beryllium neutron source. For imaging the track track etch method is used. In an inspection program the blades of nine control elements were examined. The evaluations of the images yield the amount of boron losses in relation to neutron fluence exposure of the control elements.

35903 **(INIS-mf—11231) Application of radionuclide methods in metallurgy and mechanical engineering.** (Ceska Vedeckotechnicka Spolecnost, Prague (Czechoslovakia). Komise pro Jadernou Techniku). 1987. 44p. (In Czech and Russian). (CONF-8706308—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702879/JAW.

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

42 summaries are presented of papers submitted to the national conference. The papers address the uses of radionuclides and nuclear methods in solving the actual problems of the manufacture and of quality of steel and nonferrous metals, and of the life of machine parts. (J.B.).

0703 Isotopic Power Supplies

REFER ALSO TO CITATION(S) 36783, 38913

35904 **(LA—11220-PR) Milliwatt generator project: Progress report, April 1983--March 1984.** Rinehart, G.H.; Latimer, T.W. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011261/JAW.

This report covers progress on the Milliwatt Generator Project during April 1983--March 1984. Activities included (plutonium 238 oxide) fuel processing and characterization, production of heat sources, fabrication of pressure-burst test units, compatibility studies, impact testing, examination of surveillance units, Inconel weld development, and quality assurance.

0704 Economics

REFER ALSO TO CITATION(S) 38913

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 35573, 35906, 35906, 35914

35905 **Reaction of hydrogen sulfide with dinuclear palladium(I) complexes containing bis(diphenylphosphino)methane (dpm) and conversion of bridged-sulfide derivatives to bridged-sulfoxide species. X-ray structure of the dimetallic sulfoxide $Pd_2Cl_2(\mu\text{-}SO)(\mu\text{-}dpm)_2$, containing pyramidal sulfur.** Besenyei, G.; Lee, C.L.; Gulinski, J.; Rettig, S.J.; James, B.R.; Nelson, D.A.; Lilga, M.A. (Univ. of British Columbia, Vancouver (Canada)). *Inorganic Chemistry;* **26**: No. 21, 3622-3628(21 Oct 1987).

Hydrogen sulfide reacts with the complexes $Pd_2X_2(\mu\text{-}dpm)_2$ (1) and the mixed-ligand complex $Pd_2Cl_2(\mu\text{-}dpmMe)$ under ambient conditions to yield quantitatively H_2 and the corresponding A-frame, bridged-sulfide complexes such as $Pd_2X_2(\mu\text{-}S)(\mu\text{-}dpm)_2$ [X = Cl, Br, I; dpm = bis(diphenylphosphino)methane, dpmMe = 1,1-bis(diphenylphosphino)ethane]. The sulfide complexes can be oxidized by using m-chloroperbenzoic acid of H_2O_2 to the corresponding $\mu\text{-}SO_2$ derivatives via intermediate bridged-sulfoxide (μ-SO) species. The complex $Pd_2Cl_2(\mu\text{-}SO)(\mu\text{-}dpm)_2$, in which SO acts as a 2-electron donor, with the bonding at S being pyramidal, crystallized in the tetragonal space group $P4_2$ with a = b = 21.214 (1) A, c = 14.457 (1) A, and Z = 4; the data were refined to R = 0.069 on the basis of 2452 reflections with $I \geq 2.5\sigma(I)$. Two detected isomers of $Pd_2Cl_2(\mu\text{-}SO)(\mu\text{-}dpm)(\mu\text{-}dpmMe)$ appear to result from differing orientations of the oxygen at the pyramidal sulfur atom. The spontaneous loss of SO_2 from the $\mu\text{-}SO_2$ species regenerates 1 and allows for the two-stage, catalytic process: $H_2S + 2O \rightarrow H_2 + SO_2$. Mechanistic aspects of the reaction of H_2S with $Pd_2Cl_2(\mu\text{-}dpm)_2$ are briefly discussed. The complex $PdCl_2(dpm)$ reacts with H_2S under basic conditions to give $Pd_2(SH)_2(\mu\text{-}S)(\mu\text{-}dpm)_2$. 54 references, 3 figures, 5 tables.

0802 Storage

REFER ALSO TO CITATION(S) 36473

35906 **(BNL—41106) Chemical/hydrogen energy systems: Annual report summary, January 1, 1987-December 31, 1987.** (Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 34p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008597/JAW.

The 1987 Annual Report provides background and rationale as well as technical status summaries of investigations into Chemical/Hydrogen Energy Systems. Brookhaven National Laboratory, serving as Program Field Manager on behalf of the US Department of Energy Office of Energy Storage and Distribution, manages and oversees R and D in: Water Vapor Electrolysis; Photochemical Processes for Hydrogen Production; Hydrogen Storage on Activated Carbons; and, Metal Hydride Slurry Applications.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 35929

35907 **(ADI—ENFOR051983) Feasibility assessment of biogas generation by anaerobic fermentation of pulp and paper wastes.** (Adi Ltd., Fredericton, New Brunswick (Canada)). May 1983. 79p. (CE—01432). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Five bench-scale models were operated for nine months to evaluate the feasibility of anaerobic fermentation of two pulp and paper waste streams. Two downflow filters (DFF) and an ADI-bulk volume fermenter (BVF) were fed diluted high yield spent sulphite liquor (HYSSL) at 3 different average biochemical oxygen demand (BOD) loads, and BOD removals and specific methane productions were evaluated. Dynamic testing revealed the cloth media DFF biogas production response to shock load and feed cessation. Newsprint mill primary clarifier sludge (PCS) was fed to two wood media DFFs. The fibrous nature of the PCS posed difficulties for model operation, gas collection and sample analysis. Improvements in PCS settling and dewatering were noted as a result of anaerobic digestion. Economic projections for full-scale anaerobic treatment of HYSSL and PCS were made on the basis of model results. The results of these projections indicate that anaerobic fermentation may be an economical means of extracting valuable energy from these waste streams and reducing treatment and disposal costs. A sulphur balance conducted on the HYSSL cloth DFF model indicated that 66% of the total sulphur in the waste was removed by a crude sulphide scrubber-stripping system. The scrubber-stripper concept along with anaerobic treatment offers very interesting possibilities for chemical and energy recovery and waste treatment. 30 refs., 26 figs., 14 tabs.

35908 **(ANL/CNSV-TM—195) Development of improved microbial strains for methane production from municipal solid waste and wastewater.** Ho, N.W.Y. (Purdue Univ., Lafayette, IN (USA)). Jan 1988. Contract W-31109-ENG-38. 50p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010342/JAW.

The overall objective of this sub-program is to apply genetic engineering technology for the development of methanogen-based processes for improved methane production from municipal solid waste (MSW) and waste water. Specifically, the research is directed towards achieving the following goals: (I) the development of a transformation system for Methanobacterium thermoautotrophicum and Methanosarcina mazei; and (II) genetic manipulation of the genes effecting methane generation in M. thermoautotrophicum and Ms. mazei. In the past three years, we have carried out a great deal of work towards achieving the above listed goals. Our major accomplishments during these past three years are: (a) the establishment of a selection method for the development of a transformation system for M. thermoautotrophicum and Ms. mazei; (b) construction of potential cloning vectors for the transformation of M. thermoautotrophicum and Ms. mazei; (c) establishment of ideal conditions for the isolation, purification, and fragmentation of the individual subunits of methylreductase from M. thermoautotrophicum and Ms. mazei. (These will make it possible to analyze part of the amino acid sequence of each subunits to derive the ideal oligonucleotide probes for the isolation of genes encoding these subunits); (d) successful isolation of a number of partial gene fragments via the construction of lacZ fusions. (These gene fragments will be used first to study the necessary genetic elements for gene expression in M. thermoautotrophicum. Eventually, they will be used to construct hybrid genes which can be expressed in both E. coli and M. thermoautotrophicum. Our results also demonstrate that quite a few of the genes from M. thermoautotrophicum can be expressed in E. coli); (e) development of methods for the isolation of promoters from the methanogen genes; and (f) cloning, restriction mapping, and sequence analysis of the cryptic plasmid pME2001 from M. thermoautotrophicum.

35909 **(CONF-880231—2) Potential for gas recovery from small and medium sized landfills in the southeastern United States.** Bogner, J.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01;3. Order Number DE88010029/JAW.

From Energy from municipal waste: resource recovery for small communities; Panama City, FL, USA (10 Feb 1988).

The majority of landfills in the southeastern United States are small-to-medium sized, receiving less that 600,000 cubic yards of refuse per year and covering an area of less than 100 acres. To date, most landfill gas recovery in the US has concentrated on the largest landfill sites with little consideration being given to landfills with less than about a million tons of refuse in place. Successful operation of gas recovery facilities at small-to-medium sized landfills in the UK and Europe suggests that there is potential for developing economically viable gas recovery projects at smaller sites in the US. 4 refs., 1 fig., 3 tabs.

35910 **(CONF-880702—8) Pyrolysis experiments with municipal solid waste components.** Helt, J.E.; Mallya, N. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009920/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

A majority of the combustible portion of municipal solid waste (MSW) is cellulosic in nature, comprising paper, newsprint, packaging materials, wood wastes, and yard clippings. If this material is pyrolyzed, the end products are: a highly carbonaceous solid char, a highly oxygenated liquid tar, and a mixture of gases with low to medium Btu content. All of the pyrolysis products offer the potential of being useful fuels or the intermediates for producing useful fuels. Current research at Argonne National Laboratory (ANL) is focused on obtaining a better understanding of the basic mechanisms, kinetics, and chemistry involved in the pyrolytic conversion of MSW and its components. Newsprint, kraft paper, polyethylene, and densified refuse-derived fuel (RDF) have been used individually and in mixtures as feedstock in a batch laboratory reactor. The pyrolysis has been at atmospheric pressure and temperatures of 350{degree}--800{degree}C. The products from the pyrolysis reaction have also been analyzed for both fuel properties (e.g., viscosity, calorific value, acid group concentrations) and chemical composition. The liquid products have been studied extensively using Fourier transform infrared spectrometry. Discussion is provided on the overall chemical mechanisms associated with the pyrolytic decomposition.

35911 **(CONF-8803101—1) Understanding landfill gas generation and migration.** Bogner, J.; Rose, C.; Vogt, M.; Gartman, D. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010020/JAW.

From 11. GRCDA annual international landfill gas symposium; Houston, TX, USA (21 Mar 1988).

Landfill gas research in the US Department of Energy (DOE) from Municipal Waste (EMW) Program is focusing on two major areas of investigation: (1) Landfill gas migration processes; and (2) Landfill gas generation. With regard to gas migration, a field investigation is examining bidirectional gas movement through landfill cover materials by processes of pressure and diffusional flow. The overall purpose of the study is to quantify gas loss from the landfill reservoir by natural venting and air influx due to pumping on recovery wells. Two field sites--a humid site with clay cover and a semiarid site with sand cover--have been instrumented to examine vertical gas movement through cover materials. Results from the humid site indicate that: (1) concentrations of methane, carbon dioxide, oxygen and nitrogen in soil gas vary seasonally with soil moisture; (2) based on average methane gradients in soil gas and a simple diffusion model, up to 10E5 g methane m/sup {minus /2} yr/sup {minus/1} are vented through the cover materials at the humid site (area of 17 ht); and (3) during prolonged wet weather, pressure gradients of more than 2 kPa may develop between the cover materials and top of refuse, indicating that pressure flow is periodically an important mechanism for gas transport. The second project is addressing landfill gas generation. The major goal is to develop simple assay techniques to examine the gas production potential of landfilled refuse. Refuse samples extracted from various depths in a landfill are being leached by three different methods to separate microbial mass and substrate. The leachates are being subjected to Biochemical Methane Production (BMP) assays with periodic qualitative examination of microbial populations using fluorescence microscopy of live cultures and scanning electron microscopy (SEM).

35912 **(DOE/ER/10684—T3) Methanogenesis from acetate, a key intermediate in nature: Final report.** Mah, R.A.; Boone, D.R. (California Univ., Los Angeles (USA). School of Public Health). 1988. Contract AS03-80ER10684. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008136/JAW.

It is now well appreciated that methanogenic bacteria obtain energy for growth during formation of methane from a limited range of substrates: H_2CO_2; formate; methanol; acetate; and the methylamines. Methane may also be produced from CO and methionine but these latter are not normally ecologically important substrates in nature. H_2CO_2 is used by almost all axenic cultures of methanogens except a few methanosarcinae strains. Acetate, however, appears to be restricted in nature to a smaller group of methanogens, most of which also metabolize methanol and the methylamines in addition to H_2CO_2. None of these methylotrophic methanogens have, thus far, been found to use formate. 15 refs.

35913 **(DOE/ER/13248—3) Theory on extreme thermophilic anaerobes growing over temperature spans of 40{degree}C or more: Final report for time period July 1985 through March 1987.** Wiegel, Juergen. (Georgia Univ., Athens (USA). Research Foundation). Mar 1987. Contract FG09-84ER13248. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011583/JAW.

The goal is to study properties of extreme theromophilic anaerobes. Particularly the ability of several extreme thermophiles to grow over an extended temperature tolerant thermophiles to grow over an extended temperature span of 40{degree}C or more and to examine a theory on temperature tolerant thermophiles. The working hypothesis explains the extended temperature span growth and the concomitantly observed extended intermediary plateau in the Arrhenius graph of various extreme thermophilic bacteria by postulating that they possess two sets of some enzymes. Enzymes from one set function at the lower temperature range and the enzymes from the other set at the higher temperature range. The synthesis of the respective enzymes is temperature dependent. We examined enzymes sets and the temperature dependent synthesis using growth experiments. The direct goals were to establish the observed

growth pattern and temperature sensitive mutants of Methanobacterium thermoautotrophicum which can not grow wither at the upper or lower temperature range. 22 refs.

35914 **(DOE/ER/13376—2) One-carbon metabolism in anaerobes: Organic acid and methane production: Final technical report for period June 1, 1985-May 31,1987.** Zeikus, J.G. (Michigan State Univ., East Lansing (USA). Dept. of Biochemistry). Oct 1987. Contract FG02-85ER13376. 11p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008137/JAW.

Objectives of this project dealt with understanding one- and multicarbon metabolism in acetogenic and methanogenic bacteria. The biochemistry of acetate catabolism in Methanosarcina barkeri in relation to their major enzyme activities, co-factors and intermediates were studied. The physiological function of CO-dehydrogenase was investigated and found to be involved in hydrogen production when CO was used as substrate. Hydrogen metabolism from acetate by Methanosarcina barkeri was investigated through isotope tracer studies. Results showed that hydrogen production appears to be linked to several intracellular redox processes which follow the cleavage of acetate. The metabolic pathway in Butyribacterium methylotrophicum for multicarbon metabolism was elucidated. The key enzyme, ferredoxin-NAD reductase, was found to be regulated by NADH. The one carbon and multicarbon metabolic pathways in Butyribacterium methylotrophicum were constituted. Hydrogen was produced through multicarbon metabolism and was consumed by one carbon metabolism through the reduction of CO_2. Results revealed why high efficiency of carbon and energy conservation was observed in acetogens. The catabolism of formate to acetate by this microorganism was analyzed by fermentation time course and ^{13}C nuclear magnetic resonance studies. Results indicate a bifurcated single-carbon catabolic pathway in which CO_2 is the sole single-carbon compound that directly supplies the carbonyl and methyl group synthesis pathways leading to the formation of acetyl coenzyme A, the primary reduced product. 1 fig.

35915 **(PB—88-203187/XAB) Electrochemical activation of carbon dioxide. Annual report, October 1986-October 1987.** Lewis, N.S. (Stanford Univ., CA (USA). Dept. of Chemistry). Nov 1987. 31p. NTIS, PC A03/MF A01.

See also PB—87-169850.

This report reviews recent work on the development of catalysts for the reduction of carbon dioxide and protons. Macrocyclic cobalt complexes and mono and dinuclear ruthenium porphyrins were synthesized as potential catalysts. Quantitative generation of dihydrogen was observed from the reaction of reduced ruthenium octaethylporphyrin with protons. Less-powerful reductants, such as square planar cobalt macrocyclic complexes, gave up to 80% yields of dihydrogen under similar conditions. The reaction of reduced cobalt macrocycles with carbon dioxide was observed in aprotic media.

35916 **(PNL—6520) The development of a 20-inch indirect fired fluidized bed gasifier.** Flanigan, V.J.; Sitton, O.C.; Huang, W.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 136p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88008462/JAW.

This report discusses the design, fabrication and operation of a 20" I.D. fluidized bed gasifier producing medium Btu gas. The reactor is indirectly heated using 30 x 1-inch U-tubes inserted in the inert bed. The U-tubes are heated using flue gases produced from a propane burner system located at the bottom of the reactor. The feed material was dry wood chips fed into the bed with a 6in. auger. The reactor was fed both into the bed and at the top of the bed. The fluidizing medium was superheated steam which was superheated to 1000{degree}F. The gas produced from the reactor was passed through a cyclone for char removal and routed to the flare for combustion and disposal. The parameters measured during the experimental runs were wood feed rate, steam flow rate, steam temperatures, bed temperatures, free board temperatures, product gas temperatures, bed differential pressures, char production, gas production, gas analyses, and tar production. The parameters measured in the laboratory were moisture contents (wood and char), ash contents (wood and char), and tar content. 9 refs., 19 figs., 11 tabs.

35917 **(PNL-SA—15339) Catalytic destruction of tars in biomass-derived gases.** Mudge, L.K.; Baker, E.G.; Brown, M.D.; Wilcox, W.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 16p. (CONF-880518—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009479/JAW.

From International conference on research in thermochemical biomass conversion; Phoenix, AZ, USA (2 May 1988).

The Biomass and Municipal Waste Technology Division of the US Department of Energy is sponsoring studies at the Pacific Northwest Laboratory on catalytic destruction of condensible hydrocarbons (tars) in biomass-derived gases. Currently gasifiers generate a significant amount of tars in the product gases. These tars create problems with plugging in downstream equipment and with wastewater treatment. Partial oxidation of the gas stream in a secondary fluid bed of catalyst destroys the tars in biomass-derived gases while increasing the energy content of the product gas by over 20%. Catalysts that remain active for tar destruction are used in the secondary reactor which is specially designed to promote destruction of tars and minimize oxidation of combustible gases such as CO and H_2. Results of studies with different catalysts which have been tested for this application are described.

35918 **(PNL-SA—15703) Thermochemical gasification of wet biomass and wastes.** Butner, R.S.; Elliott, D.C.; Sealock, L.J. Jr.; Neuenschwander, G.G. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 18p. (CONF-880348—4). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008179/JAW.

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Mar 1988).

Experiments conducted with a 1-liter batch reactor have demonstrated that biomass and other lignocellulosic materials can be efficiently and quickly converted to a high quality gas product by heating them as aqueous slurries to temperatures of 380{degree}C to 450{degree}C under a pressure of 30.9 to 39.9 MPa in the presence of alumina supported nickel catalyst. PNL is currently in the process of building a small scale (4 l/h or approximately 1 gal/h) continuous reactor system to perform a series of experiments designed to better characterize reaction kinetics and catalyst stability. 5 refs., 2 figs., 3 tabs.

35919 **(SERI/PR—234-3169) Low pressure upgrading of primary oils from biomass: Annual report, 1 January 1986–31 December 1986.** Diebold, J.P.; Evans, R.J.; Levie, B.E.; Milne, T.A.; Scahill, J.W. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1987. Contract AC02-83CH10093. 102p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88001125/JAW.

This report covers progress made during the period of 1 January 1986 to 31 December 1986 on the upgrading of oxygenated, primary pyrolysis oil vapors made from wood, to a high octane gasoline consisting primarily of toluene, xylenes, and trimethyl benzenes. Rapid screening tests, involving a fixed-bed of a few grams of catalyst, were performed in real time with the molecular-beam mass-spectrometer (MB/MS). The MB/MS work showed that HZSM-5 in extrudate form was significantly better in producing aromatic gasoline from the pyrolysis vapors than silicalite, HY zeolite, or silica-alumina. The effect of temperature in the 300{degree} to 500{degree}C range on the reactions was shown to dealkylate the gasolines and to increase the naphthalene yield, although overall yields appeared to be higher with increased temperatures. A slipstream of the pyrolysis vapors made in SERI's vortex reactor was passed through fixed beds of catalyst containing between 100 and 300 grams of HZSM-5 extrudate. The collected condensate was analyzed by GC-FID and confirmed the gasoline product quality predicted by the MB/MS rapid screening tests. Coke formation on the catalyst suggests this process is analogous to catalytic cracking of heavy petroleum fractions in a modern refinery rather than to the relatively coke-free methanol-to-gasoline process. Very preliminary economics are presented which indicate the potential to produce gasoline for $1.25 to $1.50 per gallon with successful development of this wood-to-gasoline process. 66 refs., 34 figs., 9 tabs.

35920 **(STEV-FGT—87-4) Studies of processes involved in biomass gasification. Final report.** Bitowft, B.; Andersson, L.; Bjerle, I. (Statens Energiverk, Stockholm (Sweden)). Jul 1987. 64p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752854/JAW.

A fundamental investigation of sintering properties of biomass during steam gasification in a fluidized bed reactor (FBR) was performed in a laboratory scale FBR (10 cm ID) at atmospheric pressure. The FBR was designed to promote clinker formation. The biomass used was wood char, 1-4 mm particle size, Geldart Group D particles. The quantity of clinker formed was considered as a function of the following variables: average bed temperature (640-910 degrees of Celsius), fluidizing velocity (12.2-38.1 cm/s), percent oxygen in steam (9.0-34.3 percent), and total oxygen flow (1.54-12.38 m/sup3//sxm/sup2/). Clinker was formed at average bed temperatures as low as 640 degrees of Celsius, but consistent behavior based on the average bed temperature was hard to determine. However there were some trends noticed between the opposing actions of the stirring action caused by fluidizing velocity and heat from combustion reactions caused by the presence of oxygen. It was shown that the total oxygen flow decribes this phenomenon better than the partial pressure of oxygen, due to oxygen's greater reactivity to carbon than steam's. Regression analysis was performed to yield an empirical equation with a reasonable correlation. Investigations of high temperature pyrolysis of biomass were carried out in a vertical tube reactor. Most of the effort during this period was directed toward finding the proper components to the vertical tube reactor unit, and perfecting the experimental method. At this time, the unit is in running order, and the experimental method has been perfected. Some of the raw data is presented here. (authors).

35921 **(STU—81-3049) Anaerobic digestion of manures in an expanded bed.** Linne, M. (Swedish National Board for Technical Development, Stockholm). 5 May 1986. 13p. (In Swedish). (STU—81-3049C; STU—81-3049D). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752972/JAW.

Conventional mesophilic fermentation of manures demands a long residence time and, consequently, large digester volumes. By introducing a carrier material on which the methane producing bacteria grows, the flow rate of organic material can be increased. In this project, the possibility to use a fluidized bed for digestion of swine manures has been examined. A pilot plant with a 0.5 m/sp3/ digester has been constructed. A carrier material is brought to fluidization using a circulation pump. At most 16 per cent of the volume could be filled with carrier pellets. This doubled the gas production compared to conventional runs. (L.E.).

35922 **(STU—83-5465) Composting of liquid manures in pilot scale.** Thyselius, L. (Swedish National Board for Technical Development, Stockholm). 24 Jun 1986. 41p. (In Swedish). (STU—81-4645). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752977/JAW.

The heat produced in composting manures has been measured. For cattle manures 50 and 160 kWh/m/sp3/ was produced for a resident time of 3 and 10 days respectively. Swine manures gave the figures 80 and 180 kWh/m/sp3/. 20 days composting of cattle manures produduced 285 kWh/m/sp3/. The experiments have shown that shorter residence times and higher organic loads can be achieved than in anaerobic treatment (biogas production). (L.E.).

35923 **(STU—84-3825) Survey of municipal biogas plants in Sweden.** Jerkbrant, B. (Swedish National Board for Technical Development, Stockholm). 19 Jun 1986. 35p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752978/JAW.

The report is the result of answers to a questionnaire and of visits to plants in the municipalities. The answers, received from 89 plants, are analyzed and discussed. Several of the plants sell the gas to district heating centrals, hospitals a.s.o., while others use the gas for producing electric power, mostly in TOTEM-units. Problems have been experienced particularly with the gas distribution system and with the discharge- and circulation system of the digester. (L.E.).

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 35924, 36709

35924 **(DOE/PC/79923—T1) The effect of chemical additives on the synthesis of ethanol: Technical progress report No. 1, September 15, 1987-December 15, 1987.** Chuang, S.S.C. (Akron Univ., OH (USA). Dept. of Chemical Engineering). 5 Jan 1988. Contract FG22-87PC79923. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007947/JAW.

The objective of this research is to elucidate the role of various chemical additives on ethanol synthesis over Rh- and Ni-based catalysts. Chemical additives used for this study will include S, P, Ag, Cu, Mn, and Na which have different electronegativities. This comprehensive research program includes investigation of the effect of additives on the surface state of the catalysts, heat of adsorption of reactant molecules, reaction intermediates, reaction pathways, reaction kinetics, and product distributions. During the first quarter of the project, a micro-reactor system has been built. $RhSiO_2$ and $Cu\text{-}RhSiO_2$ catalysts have been prepared for ethanol synthesis and reactive probing studies. CO hydrogenation was carried out with the above catalysts. Afterwards, 3-4 mole % of ethylene was added to the reactant stream. Ethylene hydrogenation was also carried out with $RhSiO_2$ and $Cu\text{-}RhSiO_2$ catalysts. 4 refs., 3 figs.

35925 **(FCC—ENFOR051982) Conversion of cellulose to ethanol using a two-stage process. Final report.** Saddler, J.N. (Forintek Canada Corp., Ottawa, Ontario). May 1982. 45p. (CE—01500). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Over 100 strains of wood-rotting fungi were initially screened for their cellulase and β-glucosidase activities. Some of these strains were assayed for extracellular cellulase activity using a variety of different solid media containing carboxymethyl cellulose or acid swollen cellulose. The diameter of clearing of these plates gave an approximate indication of the order of cellulase activities obtained from culture filtrates of these strains. Trichoderma strains grown on Vogel's medium gave the higher cellulase yields. Culture filtrates from Trichoderma sp. E58 demonstrated the highest β-glucosidase activity giving a value of 1.1 IU/mg. A variety of different cellulose and pretreated wood substrates were hydrolysed using Trichoderma culture filtrates. The importance of the pretreatment conditions and ensuing chemical extractions of the cellulosic substrates was demonstrated by the range of ethanol values obtained in simultaneous saccharification and fermentation experiments using Zymomonas mobilis or Saccharomyces cerevisiae. The rate of hydrolysis of the cellosic substrates by Trichoderma culture filtrates, concentrated culture filtrates and whole cell cultures was compared. An ethanol value of 2.2% (w/v) was obtained for 5% solka floc using concentrated culture filtrates of Trichoderma and Z. mobilis or S. cerevisiae. 37 refs., 1 fig., 18 tabs.

35926 **(GAO/RCED—87-91) Alternative fuels: Information on DOD's methanol vehicle program.** (General Accounting Office, Washington, DC (USA)). 1987. 12p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Army initiated the methanol vehicle demonstration program to establish the feasibility of using methanol as an alternative fuel for government vehicles. Army had difficulty obtaining new methanol vehicles because manufacturers were unwilling to provide the number needed for the program. Because of budget limitations the program was unable to test enough vehicles for a sufficient number of miles to decisively establish reliability and durability. The Army is examining methanol vehicle operation under cold, moderate, and hot climate conditions, but results will not be available until October 1987. In addressing support functions, the Army developed methanol fuel and lubricant specifications; methods for transporting, storing, and dispensing the fuel; and technical specifications for vehicle conversion. The program by itself contributed little to increasing the use of methanol fuel because the limited number of vehicles used did not encourage their methanol production or fuel distribution.

35927 (GAO/RCED—87-106BR) Alternative fuels: Feasibility of expanding the fuel ethanol industry using surplus grain. (General Accounting Office, Washington, DC (USA)). 1987. 73p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report examines two financing concepts in using surplus federally owned grain to further the development of the ethanol industry. They are (1) producers/developers would use surplus grain as collateral to obtain financing from lending institutions to construct new ethanol plants or expanding existing facilities and (2) producers/developers would use surplus grain as a free feedstock to produce ethanol, which could induce lending institutions to finance the construction or expansion of ethanol plants or facilities. Surplus grain inventories are large enough to support these concepts. However, producers/developers and lenders are skeptical about the concepts' usefulness for expanding the industry, given the current slump in the ethanol market. Most of producers/developers said the concepts were feasible; most lenders had little interest in the grain-as-collateral concept but were more interested in the feedstock-as-inducement concept. Department of Agriculture officials said that it is unlikely they would initiate the financing concepts unless directed by the Congress.

35928 (SERI/PR—234-3295) Mechanisms of pyrolysis of municipal solid waste: Annual report, 1 August 1985-30 July 1986. Evans, R.J.; Milne, T.A. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1987. Contract AC02-83CH10093. 63p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88001158/JAW.

Studies of the effect of heating rate on the pyrolysis mass spectra of an RDF sample and a pyrolysis oil are presented. The time evolution of many ions from RDF pyrolysis species are shown. The foundations of factor analysis of mass spectra are given and application to pyrolysis oils shown and discussed in the context of compound classes in the very complex pyrolysis vapors. 32 refs., 15 figs., 7 tabs.

35929 Promoter effect of iron on olefin hydroformylation catalyzed by SiO_2-supported rhodium-iron bimetallic carbonyl clusters: Rh-Fe^{3+} bimetallic activation of catalytic CO insertion. Fukuoka, A.; Ichikawa, M.; Hriljac, J. A.; Shriver, D.R. (Hokkaido Univ., Sapporo (Japan)). *Inorganic Chemistry;* **26**: No. 22, 3643-3645(4 Nov 1987). Contract FG02-86ER13640.

Rh-Fe bimetallic carbonyl clusters have been employed as precursor for the preparation of Rh-Fe bimetallic catalysts. The structural properties of the Rh-Fe bimetallic cluster supported on SiO_2 were studied by means of Moessbauer and ir spectroscopy of chemisorbed CO. The results reported for the hydroformylation of ethylene and propylene indicate that the Rh-Fe^{3+} species derived from SiO_2-supported Rh-Fe carbonyl clusters are highly active for migratory CO insertion. These catalysts also enhanced the simple hydrogenation reactions. The activity and selectivity of the catalysts is thought to be due to the bi-site interaction with C- and O-bonded CO that is reflected in Fe promotion for C_1-C_2 alcohol production from CO and H_2 catalyzed on the Rh-Fe catalysts. 20 references, 1 table.

35930 Sewage treatment cuts waste, creates oil. *Environment;* **29**: No. 8, 24(Oct 1987).

Sewage treatment plants in metropolitan areas yield excessive amounts of sludge that are generally buried in landfills, dumped in oceans, or incinerated. Scientists are designing a new treatment process that may reduce by 80% the volume of sludge normally generated from treatment plants and that can convert the remaining sludge to diesel fuel oil. This potentially energy-saving and profitable technique is the goal of a two-year research project of American Fuel and Power Corporation and Battelle's Pacific Northwest Laboratories. In the process, primary sewage sludge is concentrated and the 20%-solids residue mixed with alkali. This mixture is heated under pressure to convert the organic component to a crude oil that is upgraded to a diesel fuel. A pilot plant for converting sewage sludge to fuel oil is planned for completion next summer, and American Fuel and Power hopes eventually to construct the conversion plants to serve cities with populations of 75,000 or greater.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 35578, 35593, 35594, 35627, 35639, 35993, 35994, 36163, 36540, 36677

35931 (ANL/CNSV-TM—199) Processing high solids concentration of municipal solid waste by anaerobic digester for methane production. Tsao, G.T. (Purdue Univ., Lafayette, IN (USA)). Jan 1988. Contract W-31109-ENG-38. 39p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008984/JAW.

Cellulosic solids are pretreated by calcium hydroxide to produce salts of volatile orangic acids and other water-soluble substances. Pure cellulose, sawdust, and waste paper are used as model substances for the study of alkaline degradation. It is found that sawdust is more difficult to degrade than the other two substances. The cooking conditions for high conversion of model substances and high yeild of orangic acids are found to be 275{degree}C to 300{degree}C with the corresponding reaction time from 30 minutes to 15 minutes. The cooking liquor can be readily fermented in an anaerobic fluidized-bed digester for methane production. The cooking liquor from different reaction conditions can all be digested by the methanogens. Higher than 90% of COD can be removed under the conditions of low organic loading rate (<2.0 g COD/l/day) and low hydraulic retention time (1.5 to 2.0 days). 14 refs., 10 figs., 2 tabs.

35932 (NEI-DK—61) Investigation of straw-fueled heating systems and fire prevention in practice. Pt. 2. Fire investigations. (Dansk Brandvaerns-Komite, Birkeroed). Sep 1983. 65p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752805/JAW.

This report describes an investigation of fires in connection with 27 manual fired and 33 mechanically fired straw-fueled power plants. For these fires it has been investigated what types of errors, which in particular have been causing the fires and the expences, also whether it were construction errors, installation errors, lack of maintenance or human errors. Through a comparison of data collected from straw-fueled plants, which have been involved in fires and data from a suitable selection of plants in Denmark, the investigated material has been analyzed and discussed. Based on the results of this investigation, possible measures to prevent fires and improve the security in straw-fueled plants are described, i.e. approval, strict demands for installation and installation control, demands for better maintenance, user instruction and revision of fire instruction no. 22. 13 refs. (SM).

35933 (NP—8770215) Economy of different methods to produce pellets/briquettes from straw, bark, waste wood, saw mill residues, waste paper and mixed raw materials for use in small furnaces. Final report - Text volume. Kolloch, P.; Schmittinger, B.; Ortmaier, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Feb 1987. 196p. (In German). NTIS (US Sales Only), PC A09. Order Number DE88770215/JAW.

In principle biomass of various origins can, under high pressure, be compressed into pellets and briquettes to be used as fuel in furnaces. The study aims at evaluating the economic efficiency of diverse procedures to obtain and compress the material and to use it as fuel. At current fuel market prices pelleting/briquetting is economically acceptable only under specific conditions. Production costs of pelleting/briquetting vary from DM 75 to DM 140 per ton depending on raw material and press output on the assumption that the press can be run for 1,500 hours per annum. In the Federal Republic of Germany, however, few presses are run for more than 500 h/a. With costs for straw from DM 40 to DM 150 per ton, fuel costs vary between DM 0.039 to DM 0.066 per kilowatt hour. On the present fuel market straw pellets are competitive with coal as fuel for small furnaces, particularly with regard to the high price of firewood. The break-even point for straw briquettes as substitute for oil is approached at DM 0.65 per liter fuel oil. For larger furnaces (> 100 kW/h) chopped wood or straw bales are to be preferred. The market price of energy is the main factor to influence the economic use of pelleting plants. A lasting market for pellets

from waste is unlikely. Even in future their use will be confined to special groups of consumers. With 40 refs., 107 tabs., 28 figs..

35934 **(SLU-IVL—178) Wood fuels effect on breakdowns and energy losses - two heating plants.** Gaerdenaes, S. (Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Virkeslaera). 1986. 62p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752848/JAW.

The importance of forest fuel for good operation economy has for long succession of years been greatly underestimated. The two analysed hotwater boilers in the present study gave varying results. One plant was very well fitted for different assortments while in the other the requirement for fuel seem to be of great importance for operation and energy loss. For the best plant the direct efficiency varied between 82-88 per cent, while the indirect efficiency varied between 88-90.5 per cent. In the other hotwater boiler the indirect efficiency during normal conditions gave 78 per cent, while the indirect efficiency during parade conditions was calculated as 88 per cent. Analysis showed that the moisture content had to be determined very carefully in order to reduce the uncertainly in the direct method. If the indirect method was used the boiler efficiency was not influenced in the same way by incorrectness in parameter values. The accomplished fuel specification for a pilot study in heating plants, consist of: determination of fuel assortment fraction distribution, composition, energy content and density determination. A sample burned with residues is a difficult fuel.

35935 **(SNV—3025) Operational studies of four Municipal Solid Waste Incineration Plants.** Bergstroem, J.; Lundqvist, J. (National Swedish Environmental Protection Board, Solna; Svenska Renhallningsverks-Foereningen, Stockholm). Jul 1985. 103p. (In Swedish). (DRAV—25). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752938/JAW.

The report presents the results obtained from the studies of four different plants. The operational studies were carried out at the plants in Malmoe, Avesta, Uppsala and Linkoeping for approximately ten weeks at each plant. Results from each of the four plants has been reported separately. The wastes incinerated at the plants during the study were apart from the standard mixture, of untreated municipal solid waste and industrial waste, also sorted refuse (RDF) and at some plants forestry waste. Studies of the operation were carried by monitoring about 40 operational parameters on data logg. The automatic data collection was supplemented with manual sampling and analyses. The manual samples have principally been intended for calculation of dust concentration, size distribution of particles and concentration of heavy metals in particles and gas phase. The unburnt content in slag and fly ash has been determined and also hydrochloric acid in the flue gas. In addition occurrence of organic compounds like polyaromatic hydrocarbons (PAH) and chlorinated aromatics have been determined in the flue gas from two plants. In the report views are presented on dimensioning requirements for the plants comprehending equipment and design from the refuse bunker to grate system, flue gas cleaning and control system. (authors).

35936 **(SNV—3028) Fuel and compost production at three waste treatment plants.** Ajnefors, F.; Hoejlund, A. (Statens Natuurvaardsverk, Solna (Sweden); Svenska Renhallningsverks-Foereningen, Stockholm). Jul 1985. 121p. (In Swedish). (DRAV—28). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752849/JAW.

Field tests have been carried out at 3 waste treatment plants: Sundsvall, Karlshamn and Falkenberg. In Sundsvall and Karlshamn, different operation cases for the shredder have been investigated. In Karlshamn and Falkenberg, the effects on the decomposting from different composting techniques have been studied. For the Tollemache shedder in Sundsvall it appeared that by varying the flail installation on the different floors, it is possible to control the particle size and thus the quantity of RDF. For the Hazemag-Universal shreddar in Karlshamn it was possible to adjust the production of RDF by varying the distance between the tearing and the rotor wheel. In the composting tests, the same decomposing time was obtained either the raw compost was mixed with sludge or with water. By windrowing, a mature compost was obtained after 10 weeks. It also appeared that by windrow composting, an intensified turning of the compost could compensate for the lack of aeration.

35937 **(SNV—3030) Instructions for optimum operation of waste heating plants.** Bergstroem, J. (National Swedish Environmental Protection Board, Solna; Svenska Renhallningsverks-Foereningen, Stockholm). Jul 1985. 38p. (In Swedish). (DRAV—30). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752939/JAW.

The report presents views on how to optimize energy from waste plants. The basis for the evaluation is mainly data from the operational studies in four Swedish waste incineration plants. There are separate reports published from each study. The objective of this report is to bring information to the operators of the plants. They can by systematic work find and optimize the parameters which increase the combustion efficiency in their plant.

35938 **(SNV—3031) Dioxin emission from waste incineration. A literature study.** Lindfors, G.; Solyom, P.; Waltersson, E; Eriksson, G. (Statens Natuurvaardsverk, Solna (Sweden); Svenska Renhallningsverks-Foereningen, Stockholm). Jul 1985. 33p. (In Swedish). (DRAV—31). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752851/JAW.

A critical assessment of reported studies on emissions of PCDD's and PCDF's from municipal waste incineration plants indicated that very few reported results are documented in such a way that they are comparable. (authors). With 32 refs.

35939 **(SNV—3033) Technology, Economics and Environmental Effects of Solid Waste Treatment. Final report from the DRAV-project.** Bergvall, G.; , Hult, J. (Statens Natuurvaardsverk, Solna (Sweden); Svenska Renhallningsverks-Foereningen, Stockholm). Jul 1985. 103p. (DRAV—33). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752850/JAW.

The aim has been to study technology,economy and environmental effects at existing waste treatment plants. The purpose was to obtain basic information and knowledge which would promote the development of improved handling techniques, reduced operation problems and reduced environmental effects. The project has been carried out in the form of inquiries, in the form of field investigations in which 23 treatment plants (4 incineration plants and 19 separation/composting plants) have been thoroughly investigated over periods of from 1-2 days up to 20 weeks, and as well defined subprojects where important problems were studied. Further on manuals have been put together for sampling, analysis and optimal operation of plants. The results have been published in 31 separate reports. The final report summarizes the most important results. (authors).

35940 **(STEV-TB—88-4) Blending of refuse derived fuels (RDF) and coal.** Widell, B. (Statens Energiverk, Stockholm (Sweden)). 21 Dec 1987. 93p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753341/JAW.

Technical, economical and environmental requirements for blending refuse derived fuels (RDF) and coal at coal fuelled plants are studied. Production costs are discussed and combustion techniques are described. (G.B.).

35941 **(Y/DZ—386) Recycle of waste paper.** Hackett, G.D.; Harris, G.E. (Oak Ridge Y-12 Plant, TN (USA)). Jan 1988. Contract AC05-84OS21400. 28p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010837/JAW.

One of the Oak Ridge Y-12 Plant's long range goals is to reduce the amount of waste from the plant. The large amount of waste paper generated by the plant is currently buried in the state permitted landfill. Methods of recycling cardboard and paper which comply with all security requirements, health, safety, and environmental regulations of the Y-12 Plant are sought to conserve the landfill. A process to compact paper into a form which may be used as fuel and fed into the existing steam plant has been developed. A water-resistant briquette has been made from waste paper,

a binder, and coal. Laboratory and pilot scale briquetting and pulverizing tests have been completed. These briquettes have physical properties similar to those of coal. 12 tabs.

13 HYDRO ENERGY

1301 Resources And Availability

35942 **(NEI-DK—75) Hydrological province 2 Paamiut. Hydrological and climatological measurements. Data base 1987.** (Groenlands Tekniske Organisation, Copenhagen (Denmark)). Dec 1987. 53p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752917/JAW.

1302 Site Geology And Meteorology

35943 (CONF-8609418—, pp 159-175) **Laterit as construction material for dams in Nigeria.** Moser, M.A. (Bilfinger und Berger A.G., Wiesbaden (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88770212/JAW.

From Meeting and technical exhibition on construction foundations; Nuernberg, F.R. Germany (22 Sep 1986).

Laterit is an easy to handle and very economic construction material. This is illustrated on three earth dams in the northern part of Nigeria. The generation and the different types of laterit are discussed. It is shown that for the behaviour of the structures an effective quality control is decisive and the organisation as well as the duties of the laboratory section is explained.

35944 (CONF-8609418—, pp 177-204) **Dam stabilization by paste grouting at a dammed river. Planning and construction.** Heil, W.; Wittke, W. (Wasser- und Schiffahrtsamt Saarbruecken (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88770212/JAW.

From Meeting and technical exhibition on construction foundations; Nuernberg, F.R. Germany (22 Sep 1986).

In the scheme to make the River Saar navigable, the Federal Railways embankment in the Serrig pond has been partially submerged due to the raising of the mean river level by some 11.80 m. The section of embankment had to be stabilized by paste grouting in order to prevent sudden irregular subsidence of the embankment by 8-10% and to maintain the Federal Railways operations in their full extent. Two preliminary tests established the composition and mixing procedure of the paste as well as the drilling procedures. Completion of the work in the short time allowed depended on high-performance mixing plants, grouting stations and drilling equipment. The evaluation of all available data and the conclusions drawn during and after grouting demonstrate the effectiveness and success of the chosen method.

35945 (CONF-8609418—, pp 261-273) **Earth static safety evaluation of dams at water reservoirs.** Baumann, J.; Ochmann, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Grundbau und Bodenmechanik). 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88770212/JAW.

From Meeting and technical exhibition on construction foundations; Nuernberg, F.R. Germany (22 Sep 1986).

Some safety aspects of dams are not considered by standard-calculations. There are some new steps and methods presented. They concern the estimation of the behaviour of shales, seepage along concrete crossings inside dams, stability analysis, and the valuation of calculated results.

1303 Plant Design And Operation

35946 **(DOE/ID/12121—2) Low-Head Hydroelectric Power Demonstration Project, City of Gonzales, Texas: Final operation and maintenance report.** (Gonzales Electric Dept., TX (USA)). Mar 1988. Contract FC07-80ID12121. 61p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010723/JAW.

The purpose of this report is to summarize the first two years of operation of this project beginning January 1984 and ending December 1985. The report includes descriptions of equipment procurement, on-site construction contracts, and installation of turbines and generators.

35947 **(DOE/ID/12124—2) Small-Scale Hydroelectric Power Demonstration Project: Boott Hydropower, Inc., Eldred L. Field Hydroelectric Project: Final operation and maintenance report.** (Boott Hydropower, Inc., Lowell, MA (USA)). Mar 1988. Contract FC07-80ID12124. 42p. NTIS, PC A03;3. Order Number DE88010168/JAW.

This report summarizes the Project's first two years of operation with respect to output, operation/maintenance costs, and outages. 13 figs., 4 tabs.

1305 Economics And Management

35948 **(GAO/RCED—88-19) Federal electric power: Western Area Power Administration's Tracy/Livermore Transmission Project.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 21p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Western Area Power Administration is a Department of Energy agency that markets electric power generated by federal hydroelectric dams in 15 central and western states. Western is planning to construct the Tracy/Livermore transmission line and GAO found no legal basis to question Western's authority on its plan. With a direct tie line, the Livermore Laboratory will have greater flexibility in obtaining its power from other utilities. In addition, the ultimate savings to be realized from the project will depend upon the extent to which a number of events anticipated by Western's analysis in support of building the line actually occur.

1306 Environmental Aspects

35949 **(DOE/EA—0278) Proposed fish passage improvements at Three Mile Falls Diversion Dam, Umatilla River, Oregon: Finding of no significant impact.** (Bureau of Reclamation, Boise, ID (USA). Pacific Northwest Region). May 1986. 123p. NTIS, PC A06;3. Order Number DE88011444/JAW.

The Bureau of Reclamation proposes to administer the construction of fish passage and protective facilities at Three Mile Falls Diversion Dam on the Umatilla River in Oregon to increase the numbers of anadromous fish. The Bonneville Power Administration (BPA) proposes to provide funding for the project. These agencies' actions would implement section 904(d) of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program which addresses the provision of offsite enhancement to compensate for fish and wildlife losses caused by hydroelectric project development and operations throughout the Columbia River Basin. This Finding of No Significant Impact (FONSI) is the National Environmental Policy Act (NEPA) decision document for both agencies. The proposed action would improve both upstream and downstream passage by providing a new right bank ladder on Three Mile Falls Diversion Dam, modifying the existing left bank ladder, and installing rotary drum fish screens and related structures on the adjacent West Extension Irrigation District (WEID) Canal. Four other alternatives are considered in the environmental assessment (EA): a concrete apron plus a left bank ladder; a cap on the crest of the dam plus a left bank ladder; dam removal; and no action. 5 figs., 6 tabs.

14 SOLAR ENERGY

35950 (DOE/SLB—88/1) Solar Buildings Technology: Solar heating, cooling, and daylighting for buildings: Current abstracts. Smith, L.; Steele, B.C. (eds.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jan-Feb 1988. 14p. (PB—88-932901). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008291/JAW.

Solar Buildings Technology: Solar Heating, Cooling, and Daylighting for Building (SLB) announces on a bimonthly basis the current worldwide information available on solar technologies for heating, cooling, and daylighting buildings. SLB highlights research on advanced materials and solar system concepts, and information on the performance of these advanced technologies.

1401 Resources And Availability

REFER ALSO TO CITATION(S) 36627

35951 (SAND—87-2379) A comparison of typical meteorological year solar radiation information with the SOLMET data base. Menicucci, D.F.; Fernandez, J.P. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 406p. NTIS, PC A16;3. Order Number DE88009242/JAW.

Over the years the misapplication of TMY and SOLMET data has become increasingly prevalent and, in some cases, has led to improperly sized solar energy systems or incorrect conclusions from research efforts. Much of the misapplication stems from misunderstanding and confusion about the origin, design and originally intended uses of these data. This report outlines the historical development of the SOLMET and TMY data bases and discusses the various appropriate applications for them. A majority of the report is devoted to the presentation of summary solar radiation information about the SOLMET data base and associated TMY data. Solar resource summary statistics are computed for direct normal, total normal, and fixed tilt collectors at thirty-eight sites. For each site, statistical information is presented in graphical and tabular form and can be used to compare the representative TMY year to each SOLMET year. This report is specifically intended for individuals who use TMY and/or SOLMET solar radiation data in some aspect of solar system design, analysis, or operation and want information about the potential yearly variation of the solar resource in various locations throughout the US.

35952 (SERI/SP—320-3305) SERI Standard Broadband Format: A Solar and Meteorological Data Archival Format. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1988. Contract AC02-83CH10093. 53p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88001145/JAW.

This manual describes a tape archival format appropriate for use with research-level solar radiation data. It serves both as a reference for users reading data recorded in he SERI Broadband Format (SBF) and as a guide to archiving solar, meterorological, and weather data in SBF. The manual's intended audience includes solar researchers, engineers, and climatologists as well as data processing professionals. A comprehensive list of solar, meterorological, and weather parameters is included in the format. In addition, the format's flexibility allows the user to add parameters and otherwise tailor the format to meet individual needs. SBF is particularly well suited to handling broadband solar radiation data. Also, instrument orientations (viewing angles), of special interest in solar applications, are given complete, unambiguous coverage in the header for each parameter. Standardized block lengths and detailed header information make it easy to read the data. A researcher recording in this format should be able to include all the basic information a user would require to interpret the data. Blanks and nulls are interspersed in the header and between data elements to make tape dumps readable.

35953 (SERI/TR—215-3294) Uncertainty analysis for thermopile pyranometer and pyrheliometer calibrations performed by SERI. Myers, D.R. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1988. Contract AC02-83CH10093. 30p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001156/JAW.

The absolute uncertainity in the calibration of radiometers that SERI uses to measure and monitor solar radiation data is derived in this report. We briefly describe the parameters the instruments are designed to measure, the instruments we calibrate, the reference standards used, and our data acquisition equipment. We also describe calibration techniques and methodology. Each element of the calibration process is evaluated for its contribution to the total uncertainty in the calibration factor. The derivation of the calibration uncertainty discusses all sources and magnitudes of errors contributing to the final uncertainty. We use a standardized methodology, combining the estimates into a total uncertainty, or error bar, associated with the derived calibration factors for the instruments under test. The absolute values of the calibration factors have 95% probability of lying within the error limits we arrive at. 40 refs., 9 figs., 5 tabs.

1403 Economics

REFER ALSO TO CITATION(S) 36036, 38015

35954 (GAO/AFMD—87-7) Financial audit: Solar Energy and Energy Conservation Bank's financial statements for 1981 through 1985. (General Accounting Office, Washington, DC (USA)). 1987. 12p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Solar Energy and Energy Conservation Bank operates as a component of the U.S. Department of Housing and Urban Development. The purpose of the Bank is to encourage energy conservation and the use of solar energy, thereby reducing the nation's dependence on foreign energy supply sources. According to the solar Energy and Energy Bank Conservation Act, the Bank shall not exist after September 1987. The Bank's total outlay for FY 1985 was $26,946. For FY 1984 the outlay was $7,939.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 36481

35955 (NRC/E—07011981) Solar energy review and R & D plan for 1981/1982 - 1985/1986. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). 7 Jan 1981. 56p. (CE—01418). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report outlines the background, policy framework, and aims and objectives of Canada's Solar Energy Program (SEP), provides a brief review and status report on solar energy technology, considers in some detail techniques for establishing research and development priorities and developing plans directed at a specific objective, discusses other factors and their impact on the plan, and outlines a proposed SEP plan and alternatives. Considering the opportunities for energy contribution and the implication of the other factors affecting the SEP, a 5-year plan has been developed aimed at the industrial solar capability in the general areas of: small building applications; commercial, industrial, and agricultural applications, and photovoltaics. This program would place the greatest emphasis on domestic water heating and passive/hybrid space heating, considerable emphasis on small scale active space heating and active swimming pool heating and, on an urgent basis, evaluate the opportunities and feasibility of using solar energy for commerical water and industrial process heating, air preheating and drying, central solar heating, greenhouses, and lighting and of applying similar technologies for passive cooling. 10 refs., 4 tabs.

35956 Effects of land clearing on bordering winter annual populations in the Mohave Desert. Hunter, R.; Turner, F.B.; Lindberg, R.G.; Hunter, K.B. (Lab. of Biomedical and Environmental Sciences, Mercury, NV (USA)). *Great Basin Naturalist;* 47: No. 2, 234-238(30 Apr 1987). Contract AC03-76SF00012.

Construction of a 10-MWe solar thermal power plant in Daggett, California, involved clearing and leveling 53 ha of desert land. Transient offsite effects of this construction were apparent as a reduced density of annual plants within 100 m downwind of the edge of the cleared area. Schismus arabicus populations recovered within four years, but Erodium cicutarium populations did not. The effects appeared to be related more to an interaction of seed-dispersal mechanisms with the large, open space than to the obvious sand movement and deposition associated with the clearing operations. 4 references, 1 figure, 5 tables.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 35916, 35918, 35919, 35920, 35922, 35927, 35931, 35933, 35934, 35935, 35939, 36017, 36018, 36020, 36022, 36540, 36981, 37676, 37856

35957 (AD-A—190268/3/XAB) High-efficiency thin-film silicon-on-gap solar cell for improved radiation resistance. Final report, July 1986-February 1987. Culik, J.S. (Astrosystems International, Inc., Newark, DE (USA). Astropower Div.). Sep 1987. 28p. NTIS, PC A03/MF A01.

The ultimate high-efficiency silicon solar cell is a light-trapping thin-film silicon structure epitaxially grown on an oxide overcoated substrate such as silicon or gallium phosphide (GaP). In addition to high performance, this thin-base silicon device is more tolerant of radiation effects than a thick-base solar cell because this structure is less sensitive to reductions in minority-carrier diffusion length. The oxide overcoating layer, an integral part of this design, will serve as a dielectric back surface reflector leading to light trapping, and it will also eliminate dangling bonds in the overgrown silicon layer, effectively passivating the silicon-oxide interface and reducing back-surface recombination.

35958 (ANL/EES-TM—346) Nepal forestry initiative: 1986-1987 annual report. Kilpatrick, K.; Shen, S.Y.; Vyas, A.D.; Johnson, D.O. (Argonne National Lab., IL (USA)). May 1988. Contract W-31109-ENG-38. 67p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011801/JAW.

The Nepal Forestry Initiative is a project developed through discussions between the US Agency for International Development (AID) and His Majesty's Government of Nepal and managed for AID by Argonne National Laboratory. The project seeks to facilitate widespread acceptance of multipurpose tree species cultivated under various production systems. Production systems selected for research and demonstration include alley cropping, contour hedgerow, and short rotation. A site in the Dhading District of the Mid-Hills Region of Nepal is serving as the first project site. Site delineation, shed construction, and the first stage of terrace building have been completed. Planting stock for several native species and some exotic species has been collected, and attempts to propagate these species in the nursery have begun. A socioeconomic survey of the people who will be directly affected by the project was conducted. It was followed by a survey to identify the multipurpose tree species being used by the local population. Two advisory committees -- a technical advisory committee and a social/cultural advisory committee -- have reviewed the initial project document and the progress through September 1987. Their written evaluations are appended to this report.

35959 (BCR—ENFORBCX284) Predicting logging residues in British Columbia. Tunner, A.; Standish, J.T. (B.C. Research, Vancouver (Canada); Talisman Land Resource Consultants, Vancouver, British Columbia (Canada)). 1986. 47p. (CE—01453). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A computer simulation model is presented which allows the calculation of residual biomass following conventional harvesting. The model is applicable to British Columbia, and requires the user to specify the level of tree utilization and to provide forest stand data (Compartment Area Statement) available from the British Columbia Ministry of Forests. However, it can be used to give estimates for any forest stand that a user may specify. Outputs are in total tonnes by tree component (stem wood, stem bark, three size classes of branches and foliage). The model applies biomass equations and uses modified form of merchantablility, decay, waste and breakage factors to estimate the amount of biomass removed by logging according to specified utilization limits. Biomass removed by logging is subtracted from the standing biomass (before logging) to arrive at the residual biomass. The purpose of the model is to estimate forest biomass that is potentially available for energy conversion. Such estimates are needed for decision making in energy policy as well as more specific decisions on the need for and location of biomass conversion plants. 25 refs., 1 fig., 34 tabs.

35960 (CFS/MA—ENFORMX139) The economics of harvesting fuelwood under four different stand conditions on Prince Edward Island. Peters, D.C. (Canadian Forestry Service, Fredericton, New Brunswick. Maritimes Div.). 1982. 8p. (CE—01498). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The forests of Prince Edward Island have been subjected to highgrading and neglect for 300 years. An opportunity exists to rehabilitate many of the Island woodlots by cutting fuelwood and thinning. Woodlot productivity would thus be improved in many areas and fuelwood could be provided to an expanding market. This study had two major objectives: to demonstrate and evaluate the economics of harvesting fuelwood under different, but typical, stand conditions, and to improve the productivity and value of Island woodlots. Selective harvesting using modified smallscale equipment was carried out in four stand types: immature (pole-size) tolerant hardwood, mature softwood/intolerant hardwood, mature softwood/tolerant hardwood, and immature softwood. The primary end product is fuelwood. Records of labor cost, volume extracted, equipment modification and maintenance cost, and market value of extracted wood are documented for each stand type. In the four stand types studied, the mature softwood/tolerant hardwood thinning proved to be the only profitable operation under the conditions encountered. With improved thinning rates and better operating conditions, three of the four operations might, at least break even or be profitable. This, in addition to the future benefit of an improved stand, would be an attractive incentive for stand improvement. The tractor/modified trailer and the snowmobile/sled exhibited the best extraction rates, and under favorable conditions, the tractor/manual trailer showed an acceptable extraction rate. 6 refs., 8 figs., 6 tabs.

35961 (CFS/PNFI—ENFOR31984) The role of chemical fertilizers in intensive forestry. Burgess, D. (Institut Forestier National de Petawawa, Chalk River, Ontario (Canada)). 1984. 50p. (CE—01461). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper is aimed at giving insight into the efficient use of chemical fertilizers in forestry. The approach followed involves maintaining a broad perspective while examining those factors which play a major role in determining how fertilizers are used. Such factors have been discussed elsewhere, but the information tends to be scattered or presented within a limited framework. Forest management is becoming more intensive and this trend is expected to continue as the demand for wood for energy and more conventional wood products continues to increase. There is an urgent need to develop ways of increasing fibre yields without harming the productivity of forest soils. Information is presented here on the mineral requirements of higher plants. The influence of forestry on nutrient availability, fertilizer types and their application, and limitations on fertilizer use are also discussed. These discussions provide a background to the section on principles of efficient use of fertilizers, which can serve as a guide to forest managers interested in using chemical fertilizers. Future research needs re-

lated to forest fertilization are also described. 96 refs., 3 figs., 18 tabs.

35962 **(CFS/SF—LAUX50) Implications of whole tree harvesting for biomass recovery.** Routhier, J.-G. (Canadian Forestry Service, Sainte Foy, Quebec). Dec 1981. 134p. (In French). (CE—01439). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

If trees are delimbed and topped at a plant site rather than at the cutting area, their limbs and tops can more readily be used for energy production. In the green state, recovered limbs and tops constitute a biomass of 200 to 300 kgm^3 of merchantable wood for softwood species in eastern Canada. Full trees can be harvested and transported on private roads without major difficulty. A plant concept for delimbing, topping, slashing and debarking trees is presented in this report. The elimination of delimbing in the forest promotes mechanization of felling and skidding operations. If the additional biomass that is recovered can be sold at $35 per oven-dry tonne, a much lower price than the energy-equivalent amount of oil ($54), then the additional investments required in the forest and at the mill to recover the biomass yield an after-tax rate of return at real prices (no inflation) of 27%. Chipping full trees in the forest and purifying the chips at the mill is a process now being developed that offers the pulp and paper industry another means of recovering a maximum amount of biomass. Current knowledge of this technique indicates that its economic potential is comparable to that of processing full trees at a plant. 7 refs., 22 figs., 27 tabs.

35963 **(CONF-880181—1) Modeling the primary events of photosynthesis using chlorophyll containing fixed distance donor-acceptor molecules.** Wasielewski, M.R.; Johnson, D.G.; Svec, W.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010033/JAW.

From U.S.-Japan information exchange seminar; Kyoto, Japan (8 Jan 1988).

Two specific questions that we addressed are: how does the dimeric primary electron donor in photosynthetic proteins initiate charge separation, and how do electron transfer reactions from chlorophylls to quinones depend on free energy of reaction and the surrounding medium. 1 fig.

35964 **(CONF-880215—5) Sustainable multipurpose tree production systems for Nepal.** Shen, S.Y.; Kilpatrick, K.J. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31-109-ENG-38. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011969/JAW.

From Energy from biomass and wastes; New Orleans, LA, USA (15 Feb 1988).

Argonne National Laboratory is developing methods for producing reforestation plating stock, fuel, and fodder in a sustainable manner in Nepal. This project, in cooperation with the Ministry of Forest and Soil Conservation of Nepal, is sponsored by the US Agency for International Development (AID). Several production systems are being evaluated for the Mid-Hills Region of Nepal. To provide sustainable biomass production and ecological management of the fragile Mid-Hills Region, the production systems must simultaneously satisfy the physiological requirements of the plants, the symbiotic requirements of the plant and the microorganisms in its rhizosphere, the physicochemical requirements of nutrient and water cycling, and the climatic and topographic constraints.

35965 **(CONF-8709271—Absts.) Bio Technica Hannover '87. Conference abstracts.** (Deutsche Messe- und Ausstellungs-A.G., Hannover (Germany, F.R.)). 1987. 67p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88770212/JAW.

From 3. international exhibition and congress for biotechnology (BIOTECHNICA-3); Hannover, F.R. Germany (22 Sep 1987).

The conference papers deal with biotechnological processes in the field of medicine, genetic engineering, production of proteins, peptides and hormones.

35966 **(DOE/ER/10590—2) Factors governing light driven electron and proton translocation in proteins across membranes.** Dutton, P.L. (Pennsylvania Univ., Philadelphia (USA). Dept. of Biochemistry and Biophysics). [1988]. Contract AC02-80ER10590. 25p. NTIS, PC A03;3. Order Number DE88011120/JAW.

A series of preliminary studies showed that both the direct electrical and the Q/sub A/ replacement avenues of approach were feasible. That the reaction centers could be incorporated in planar bilayer membranes to a density of {approximately}10^9 cm/sup {minus/2} was determined and with metal electrodes on either side of the supporting membranes flash activated voltages and transient currents could be monitored. The reaction centers were deposited in a 50:50 mix of vectorially opposing populations. By this approach, simple optical studies cannot easily be performed on the film either alone or simultaneous with electrical assay. The successful construction of reaction center mono (and multi) layers formed in a Langmuir Blodgett trough and deposited on planar solid supports was demonstrated. A simple spectrophotometric analysis was done on the dry film. Direct transmission assay of the optical properties of single monolayers supported the finding of {approximately}5 {times} 10^{12} raction centes cm/sup {minus/2}; linear dichroism showed that the orientation of the reaction center chromophores were as found in vivo. The reaction centers responded to flash activation.

35967 **(DOE/ER/13198—3) Structure and function of Frankia vesicles in denitrogen fixation by actinorhizal plants: Annual technical progress report for period January 1, 1987-November 15, 1987.** Torrey, J.G. (Harvard Univ., Petersham, MA (USA). Harvard Forest). 20 Nov 1987. Contract FG02-84ER13198. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007937/JAW.

Frankia is a filamentous soil bacterium of the Actinomycetales that is capable of fixation of atmospheric dinitrogen both in the free-living state and within root modules of a number of woody dicotyledonous plants in a symbiotic process. The bacterium is of special interest because of its genetic capacity to differentiate terminal swellings of the hyphal filaments called vesicles. Vesicles form in the free-living organism when deprived of combined nitrogen substrates under aerobic conditions. A multilaminate envelope surrounds the vesicle providing a barrier to direct exposure of the oxygen-labile nitrogenase enzyme that forms within the vesicle. In root nodules, vesicles may or may not form, depending upon the structural configuration of the host plant cells, the ambient oxygen concentration surrounding the root nodule and the expression of host-microbial interactions under the control of the two genomes. Under varying stresses of nutrient availability and the changing gaseous environment, remarkable adaptations may occur in either or both partners of the symbiosis to optimize dinitrogen fixation. 9 refs.

35968 **(DOE/ER/13255—1) [Hydroxyproline-rich glycoprotein of the plant cell wall]: Report on work from June 1987 to June 1988.** (Washington Univ., St. Louis, MO (USA)). 1988. Contract FG02-84ER13255. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010534/JAW.

In soybean seed costs the accumulation of the hydroxproline-rich glycoprotein extensin is regulated in a developmental and tissue-specific manner. The time course of appearance of extensin during seed development was studied by Western blot analysis and by immunogold-silver localization. Using these techniques extensin was first detected at 16 to 18 d after anthesis, increasing during development to high levels at 24 d after anthesis. Immunogold-silver localization of extensin in the seed coat showed marked depostion of the glycoprotein in the walls of palisade epidermal cells and hourglass cells. The immunolocalization of extensin in developing soybean seeds was also made by a new technique - tissue printing on nitrocellulose paper. This technique shows that extensin is primarily localized in the seed coal, hilum, and vascular elements of the seed.

35969 **(DOE/ER/13261—2) Electrochemical and optical studies of model photosynthetic systems: Progress report, July 1, 1987-June 30, 1988.** Cotton, T.M. (Nebraska Univ., Lincoln (USA). Dept. of Chemistry). 15 Feb 1988. Contract FG02-84ER13261. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009291/JAW.

During the first eight months of this funding period, we have continued our studies of photosynthetic model systems using Langmuir-Blodgett monolayers, self-assembled monolayers, and vesicles. These model systems were characterized by electrochemical and optical methods (resonance Raman, UV-Vis, and surface-enhanced resonance Raman scattering (SERRS) spectroscopy). A number of different redox-active molecules were examined in addition to the natural photosynthetic pigments. A brief summary of the results is discussed.

35970 **(DOE/ER/13465—3) Magnetic resonance and optical spectroscopic studies of radiation produced radicals: Progress report, December 1, 1985-November 30, 1988.** Kispert, L.D. (Alabama Univ., University (USA). Dept. of Chemistry). May 1988. Contract FG05-86ER13465. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011527/JAW.

The role of a host lattice of carotenoids were studied in the formation of radicals and excited singlet and triplet states that are relevant to photosynthesis. Particular emphasis is being placed on determining what is special about carotenoids that natural photosynthetic systems require them as antennae as well as for protection. The host matrix was manipulated so as to understand the carotenoid function of protection, quenching, energy transfer and antenna and also the structure of carotenoid cations. To characterize their properties, we have carried out EPR, optical, molecular orbital and electrochemical studies of carotenoid cations produced chemically, electrochemically, radiolytically (x-ray irradiated freon matrices) and photolytically (solution photolysis by excimer radiation) as a function of the host matrix. 42 refs.

35971 **(DOE/ER/13602—2) Environmental stress mediated changes in transpirational and translational regulation of protein synthesis in crop plants: Progress report, 1987--1988.** Key, Joe L. (Georgia Univ., Athens (USA). Dept. of Botany). Apr 1988. Contract FG09-86ER13602. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011580/JAW.

These studies have emphasized the characterization of HS cDNA and genomic clones, development and partial characterization of a HS-cassette for expression of various genes under the control of a very strong HS promoter, analyses on the regulation of the HS response and some aspects of thermotolerance using amino acid analogues, including studies of arsenite and cadmium on HS and thermotolerance. 11 refs.

35972 **(DOE/ER/13694—1) Partial support of a workshop entitled Rubisco '87, ribulose 1,5-bisphosphate carboxylase-oxygenase genes, proteins and the regulation of activity. Final performance report.** Jensen, R.G. (Arizona Univ., Tucson (USA). Dept. of Biochemistry). 25 Apr 1988. Contract FG02-87ER13694. 6p. (CONF-8704103—Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88010814/JAW.

From International workshop on ribulose-1,5-bisphosphate carboxylase/oxygenase; Tucson, AZ, USA (20 Apr 1987).

An international workshop on the properties of the ribulose 1,5-bisphosphate carboxylase/oxygenase (Rubisco) and its involvement in photosynthesis was held in Tucson, AZ on April 20-25, 1987. Attending were 100 participants with 42 invited speakers coming from the US, Europe (England, France, West Germany, Sweden, Denmark), Japan and Australia. All aspects of this key enzyme in photosynthesis was discussed with much new information presented. New aspects on the regulation of CO_2 fixation activity was presented including the role of the Rubisco activase and 2-C-carboxyarabinitol 1-phosphate in intact leaves. The biochemistry of the protein subunits was discussed with emphasis on the function of the small subunit. Advances on the three dimensional structure with overlap of each active site on a neighboring subunit was described. The expression of the genes, similarities in the protein structure and their genetics was compared. Various aspects of the transport of the small subunit precursor into the chloroplast and its assembly into the holoenzyme were also discussed.

35973 **(DOE/ER/13743—1) Unraveling photosystem II: Progress report, July 1, 1987-February 1, 1988.** (Harvard Univ., Cambridge, MA (USA). Dept. of Biology). 1988. Contract FG02-87ER13743. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011522/JAW.

This project addresses the identification and characterization of thylakoid proteins and to understand their organization and function in photosynthesis. One segment of the work is to develop a reliable system for transforming, with foreign DNA, the cyanobacterium Synechocystis 6803 (S. 6803), which carries out oxygenic photosynthesis in the same manner as higher plants do and is a facultative photoheterotroph. The second part of the program deals with identifying photosynthetic genes coded by chloroplast DNA in higher plants. In the course of sequencing maize chloroplast DNA, unidentified open reading frames for proteins have been encountered. The protein products of these genes are found in photosynthetic membranes of chloroplasts and cyanobacteria; in some cases traced to a functional thylakoid complex. To date, two S. 6803 genes corresponding to chloroplast genes for hitherto unrecognized thylakoid proteins have been identified and cloned. Another objective of the development of the transformation-gene deletion-gene replacement system is to be able to study functions of parts of a protein.

35974 **(DOE/SR/00870—41) Vesicular-arbuscular mycorrhizae and the enzymatic utilization of inorganic phosphate by plant roots: Progress report 1985.** Marx, D. H. (Forest Service, Athens, GA (USA). Southeastern Forest Experiment Station). 1985. Contract AI09-76SR00870. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011508/JAW.

It is well known that phosphorus absorption, especially from soil with low phosphorus levels, by plant roots can be enhanced by mycorrhizal infection. Root cortical cells colonized by vesicular-arbuscular mycorrhizal fungi (VAM) have higher concentrations of phosphorus than noninfected cells. Polyphosphate is the major phosphorus reserve in many fungi and is reported to be present abundantly in young and proliferating arbuscules. We propose that mycorrhizal polyphosphate can be utilized by the VAM-plant symbiont system as a phosphorus donor and an energy source in the glycolytic pathway, possibly after being hydrolyzed to pytrophosphate (PPi). The VAM systems of infected and noninfected roots of sweetgum (Liquidambar styraciflua L.) and onion (Allium cepa L. var. Texas Grand) were used to compare the activity of PPI-dependent phosphofructokinase (PFK), an enzyme utilizing PPi to convert frutose-6-phosphate into fructosel,6-bisphosphate. The ATP-PKF activity was measured also. 1 fig., 3 tabs.

35975 **(DOE/SR/00870—43) Vesicular-arbuscular mycorrhizae and the enzymatic utilization of inorganic phosphate by plant roots: Progress report 1987.** Marx, D. H. (Forest Service, Athens, GA (USA). Southeastern Forest Experiment Station). 1987. Contract FG02-85ER45211. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011506/JAW.

Whether the first-order lateral roots (FOLR) of tree seedlings is important in determining the competitiveness of individual sweet gums would be advantageous in a forest environment was investigated . We have hypothesized that large seedlings would have larger numbers of FOLR and thus would be more competitive. It was found however with half-sib sweetgum progeny that increasing seedling size through mycorrhizal fungi manipulation or through increasing fertility levels had no significant affect upon the number of FOLR. This suggested that FOLR might be under considerable genetic control and could, therefore, be of importance in predicting the future performance of an individual seedling.

35976 (IFU-B—08/86) Supervision and process technological optimization of the biogas plants Harrer and Trummer. Final report. Brunner, N.; Padinger, R. (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). Apr 1986. 79p. (In German). Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung.

The project 'Supervision Harrer/Trummer' is part of a comprehensive research programme in 6 biogas plants to evolve guidelines for rapid and reliable choice of the optimum rating and operational size of agricultural biogas plants. The project comprised the process technological supervision and optimization of the biogas plants 'Harrer' at Stenzengreith/Styria and 'Trummer' at Gnas/Styria during the years 1983, 1984 and 1985. The report describes all the activities conducted at the two biogas plants to the end of 1985 and summarizes the practical experience gained. (orig.) With 10 figs., 1 tab..

35977 (IFU-B—12/86) Setting up of a measuring system and implementation of a test and measurement programme at the biogas plant Spitzer. Final report. Padinger, R.; Brunner, N. (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). Apr 1986. 28p. (In German). Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung.

The project 'Measuring programme Spitzer' is part of an investigation programme in 6 biogas plants to evolve optimum rating and operation parameters for agricultural biogas plants. It comprises the setting up of a test programme for the biogas plant 'Spitzer' and the recording of all essential process parameters during the period of investigation September 1985 to December 1985. The biogas plant 'Spitzer' is equipped with a fermenting vessel made of steel in the form of a lying cylinder which is 7 meters long and 2.3 meters in diameter. The fermenting vessel thus has a capacity of about 30 cubic meters. In the longitudinal axis of the fermenting vessel there is the shaft of a stirring device with six paddels welded to it in helicoidal sequence. The biogas fuels a motor-and-generator unit (6 kilowatts/sub el/) for power generation. The waste heat from the motor-and-generator unit is used to heat the substrate in the fermenting vessel. The measuring values obtained during the short investigation period permit no exact forecast of the long-term operational behaviour of the biogas plant 'Spitzer'. Nonetheless, some essential properties of the biogas plants could be investigated. These make it possible to judge the plant in comparison with the remaining five biogas plants of the research project 'Comparative measurements in biogas plants'. (orig.RB) With 4 figs., 5 tabs..

35978 (IFU-B—21-85) Start-up processes in biogas plants. Pt. 2. Final report on stage 2 of the research project. Panholzer, M.; Scheucher, P. (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). Aug 1985. 30p. (In German). Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung.

Investigations were carried through on possibilities for shortening the normally very long start-up phases and for responding to functional disturbances in biogas plants by means of additives or start-up cultures. Commercial additives have proved inefficient. Nor is there any reason to expect that such additives will be developed in future. The use of start-up cultures from methane bacteria, too, which could accelerate fermentation, has proved to be not feasible, since the production and conservation of cultures in the quantities needed for practical purposes is too demanding on the one hand and since, on the other hand, no clearly positive effect can be observed. (orig.) With 10 figs., 3 tabs..

35979 (IFU-B—46/85) Implementation of a test and measuring programme at the Harrer biogas pilot plant. Final report. Padinger, R.; Brunner, N. (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). Apr 1986. 38p. (In German). Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung.

The 'Harrer measuring programme' is part of a research project in 6 biogas plants to evolve optimum rating and operational-size values for agricultural biogas plants. The project comprises the setting up of a test programme for the 'Harrer' biogas plant, and the recording of all essential process parameters during the period of investigation January '83 to December '85. The programme comprises measurements of the gross gas yield, the plant's own gas requirement, control of substrate quantities, temperatures, and pressures in different places of plant and pipes, as well as measurements of the electric power requirement and the hours of operation of different units. In addition, analyses of fresh substrate, of substrate in the fermenting vessel and substrate after fermentation, and gas analyses are carried through. The results and first evaluations are presented in this report. (orig./RB) With 18 figs., 7 tabs..

35980 (LBL—25042) Electron spin echo spectroscopy of photosynthesis. Britt, R.D. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 214p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88009809/JAW.

The initial light-driven electron transfer event in plant photosynthesis creates an electron-deficient pigment molecule with sufficient oxidative potential to strip electrons from water. The water oxidation process is cyclic, with intermediate states designated S_0 through S_4. Each photooxidation of the primary pigment induces a transition in the cycle. Molecular oxygen is released after four photo-oxidation events, and the complex resets to the least oxidized state, S_0. The water oxidation chemistry is performed by a membrane-bound protein complex containing the transition metal manganese. The structure of the Mn complex has been partially characterized by x-ray spectroscopy and electron paramagnetic resonance (EPR). Details of the design and construction of a high-power pulsed EPR spectrometer to perform Electron Spin Echo (ESE) to do experiments on the Mn complex instrument are presented. We are interested in measuring the magnetic dipolar and electric quadrupolar parameters of paramagnetic nuclei magnetically coupled to the Mn complex. The ESEEM technique has provided details of the chemical environment of ^1H, ^2H, and ^{14}N nuclei in the vicinity of the photosynthetic Mn cluster. We discuss possible roles for coordinated imidizole in the functioning of the water oxidation complex. The increase in ^{14}N modulation may result from directly coordinated ammonia. ESEEM studies following incubation in ^2H_2O buffers indicate water coordination to Mn in the S_2 state. However, water does not bind to Mn during the $S_1 \rightarrow S_2$ transition. 210 refs., 76 figs., 2 tabs.

35981 (LBL—25145) Light regulation of the cell cycle and gene expression in Euglena gracilis bacillaris. Yee, Muhching. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 146p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88010359/JAW.

Light regulation of the cell division cycle in the photosynthetic unicellular alga Euglena gracilis bacillaris was studied. By inoculating stationary phase, non-dividing cells into fresh media, and exposing the diluted cells to either light or darkness, it was determined that initiation of DNA synthesis is light dependent and requires continuous exposure to more than six hours of light. It is proposed that this is to allow the accumulation of an initiating factor that will enable DNA synthesis to begin. The initiating factor has a half-life of 5 hours in the dark. Flow cytometry analysis shows that once cells are committed to the cell cycle, they will complete the cycle in the dark. The levels of several photosynthetic messenger RNAs have been studied under alternating light-dark conditions and continuous light conditions. RNA levels for psbA, which encodes the Photosynthem II herbicide binding protein known as D1, display a strong circadian rhythm that persists for more than 3 days in continuous light. RNA levels for rbcL, which encodes the large subunit of ribulose 1,5-bisphosphate carboxylase, and for rbcS, which encodes the small subunit of that enzyme, have a shorter free-running circadian cycle. The chloroplast-encoded rbcL is more sensitive to cell cycle state because it does not accumulate in stationary phase cultures while the nuclear-encoded rbcS does accumulate.

35982 (NEI-DK—73) Proposal for activity plan for research programmes. (Dansk Brandvaerns-Komite, Birkeroed). Jan 1986. 49p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752916/JAW.

As a result of performed interviews and studying of literature the committee has concluded, that there is a special need for funding of basic research within parts of the following areas: - pro-

duction of biomass for energy purposes - energy conservation in connection with production and use of biomass - production of energy sources from biomass - conversion and storage of biomass energy - use of fuel produced from biomass. The committee recommend that as a part of evaluation of future projects, economic considerations will be carried out, based on current market conditions and expectations of the future development. (SM).

35983 **(PB—88-191689/XAB) Highly stocked coniferous stands on the Olympic Peninsula: chemical composition and implications for harvest strategy. Forest Service research paper.** Little, S.N.; Waddell, D.R. (Forest Service, Portland, OR (USA). Pacific Northwest Research Station). Oct 1987. 36p. (FSRP-PNW—384). NTIS, PC A03/MF A01.

This report presents an assessment of macronutrients and their distribution within highly stocked, stagnant stands of mixed conifers on the Quilcene Ranger District, Olympic National Forest, northwest Washington. These stands consisted of predominantly three species: western hemlock (Tsuga heterophylla), coast Douglas-fir (Pseudotsuga menzeisii), and western redcedar (Thuja plicata). Preliminary investigation suggests that the living crown contains a small portion of the nutrient capital on the site. Extracting this material from the site during harvest or site preparation should not pose a threat to future production of biomass. Bioassays suggested that no macronutrients were deficient for growth of Douglas-fir seedlings.

35984 **(SAND—87-2746C) Vacuum apparatus for a photovoltaic device fabrication laboratory.** Beavis, L.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-880415—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008116/JAW.

From European vacuum conference; Salford, UK (11 Apr 1988).

When fabricating photovoltaic cells, the final processing steps include depositing conducting metal layers and anti-reflective (AR) coatings on the cell. Conductors deposited include aluminum, titanium, palladium, silver, and metal nitrides and silicides. AR coatings include oxides of silicon, tantalum, aluminum, and titanium. In order to obtain maximum cell efficiency, the vacuum system must be designed to maintain the highest possible purity of deposited meterials and to prevent cells from being exposed to energetic radiation. Thermally evaporated source materials in vacua approaching UHV are preferred for this application. The design of a vacuum system optimized for producing photovoltaic cell applications and automated using a computer is described. 3 refs., 5 figs., 2 tabs.

35985 **(SAND—87-7025) Liquid metal thermal-electric converter electrode development.** Martinez, J.I. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 70p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88009252/JAW.

This report describes work done in support of distributed receiver technology development. Dish-electric systems are being pursued in an effort to circumvent the need for energy transport by providing for heat-to-electricity energy conversion by individual heat engines at the focal point of parabolic dish concentrators. The Liquid Metal Thermal-Electric Converter is an engine that can convert thermal energy to electricity without the need for moving parts. The report documents the results of contracted work in the development of a long-lifetime, high-performance electrode for LMTEC, including the materials prepared for it. 17 refs., 20 figs., 3 tabs.

35986 **(SAND—88-0865C) A comparison of the radiation tolerance characteristics of multijunction solar cells with series and voltage-matched configurations.** Gee, J.M; Curtis, H.B. (Sandia National Labs., Albuquerque, NM (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. Contract AC04-76DP00789. 7p. (CONF-8804122—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009468/JAW.

From 9. space photovoltaic research and technology conference; Cleveland, OH, USA (19 Apr 1988).

The effect of series and voltage-matched configurations on the performance of multijunction solar cells in a radiation environment was investigated. It was found that the configuration of the multijunction solar cell can have a significant impact on its radiation tolerence characteristics.

35987 **(SERI/PR—213-3291) Photovoltaic Measurements and Performance Branch: Annual report, FY 1987.** Matson, R.J. (ed.). (Solar Energy Research Inst., Golden, CO (USA)). Jan 1988. Contract AC02-83CH10093. 110p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number TI88001142/JAW.

The Photovoltaic (PV) Measurements and Performance Branch of the Solar Energy Research Institute (SERI) provides extensive PV materials, device, and component characterization, measurement, fabrication, and modeling research and support for the international PV research community in the context of the US Department of Energy's PV Research Program goals. This report summarizes the branch's progress from 1 October 1986 through 1 October 1987. The five technical sections present a succinct overview of the capabilities and accomplishments of the various research groups in the branch, namely, surface and interface analysis, materials characterization, devices and modeling, cell performance and electro-optical characterization, and advanced module testing and performance. The report highlights the main research projects completed in FY 1987, including more than 7000 measurements and tests of PV materials, cells, submodules, and modules, which resulted in more than 100 branch-originated journal and conference publications, in collaboration with or in support of about 130 university, industrial, government, and in-house research groups. 11 refs.

35988 **(SERI/STR—211-3214) Low-band-gap, amorphous-silicon-based alloys by photochemical vapor deposition: Final report, 1 October 1985--30 November 1986.** Baron, B.N.; Hegedus, S.S.; Jackson, S.C. (Delaware Univ., Newark (USA). Inst. of Energy Conversion). Feb 1988. Contract AC02-83CH10093. 28p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001165/JAW.

Thin films of hydrogenated amorphous silicon-germanium alloys were deposited by mercury-sensitized photochemical vapor deposition using a novel photo-CVD reactor. Thin films of a-Si/sub 1-x/Ge/sub x/:H with 0 less than or equal to x less than or equal to 1 and 1.0 less than E/sub g/ less than 1.8 eV were deposited from mixtures of silane and disilane with germane and inert gas diluents at substrate temperatures from 160{degree} to 200{degree}C. Alloy films were characterized by measurements of photo- and dark conductivity, electron mobility-lifetime product, sub-band-gap absorption, and density of states. Dilution with hydrogen increased the photoconductivity to 10/sup {minus/5} Scm and mobility-lifetime product to 6 {times} 10/sup {minus/8} cm²V for alloys having a band gap of 1.4 eV.

35989 **(SERI/STR—211-3215) Device physics related to the granular nature of $CuInSe_2$ solar cells: Annual subcontract report, 1 April 1986-31 March 1987.** Sites, J.R. (Colorado State Univ., Fort Collins (USA). Dept. of Physics). Feb 1988. Contract AC02-83CH10093. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001159/JAW.

Several aspects of the impact of $CuInSe_2$ polycrystallinity on solar cell performance were investigated. Reflection measurements on a variety of $CuInSe_2$ layers and completed cells show large variations in both the magnitude and angular distribution of scattered light. Localized illumination reveals spatial variations in photovoltaic response which imply collection losses as high as 10%. Capacitance studies allow extraction of the density of extraneous electronic states at the diode junction. These decrease in reverse bias but increase under illumination and, hence, forward bias. A physical model of polycrystalline $CuInSe_2$ is presented, and finally the status of $CuInSe_2$ cells is analyzed in terms of the extent to which various factors are limiting performance.

35990 **(SERI/TP—211-3354) SERI's photovoltaic research project: A foundation for tomorrow's utility-scale electricity.** Mitchell, R.L.; Surek, T. (Solar Energy Research Inst., Golden, CO (USA)). May 1988. Contract AC02-83CH10093. 11p. (CONF-880702—12). NTIS, PC A03;3. Order Number DE88001161/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

This paper focuses on recent progress and future directions in PV research managed by SERI for the US Department of Energy (DOE). The primary emphases of the research are on thin-film single-junction and multijunction devices. However, work also continues on advanced crystalline silicon sheet materials. Improvements in materials and processing, solar cell design, and cell fabrication techniques have led to continuing improvements in cell efficiencies in nearly all material areas. Recent research has identified the criticality of source-material purity and device-processing conditions for different PV materials. Attention to total device design and processing has increased our understanding of metallic contacts, transparent conductors, and intermediate layers. Sophisticated models have been developed to quickly assess device concepts. Enhanced measurement and characterization techniques, along with increased interactions among PV scientists, are adding to the strong foundation of photovoltaics. Future directions in PV research are given in the recent Five Year Research Plan prepared by DOE. The plan is predicated on partnerships among the federal government, private companies, universities, and electric utilities. As part of a consensus review of the plan, this multifaceted PV community identified the specific technical goals and pertinent R & D needed for success. These technical goals and future research are described in detail.

35991 **(SERI/TP—231-3325) An outdoor test facility for the large-scale production of microalgae.** Johnson, D.A.; Weissman, J.; Goebel, R. (Solar Energy Research Inst., Golden, CO (USA); Microbial Products, Inc., Fairfield, CA (USA)). Mar 1988. Contract AC02-83CH10093. 12p. (CONF-880215—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001146/JAW.

From Energy from biomass and wastes; New Orleans, LA, USA (15 Feb 1988).

The goal of the US Department of EnergySolar Energy Research Institute's Aquatic Species Program is to develop the technology base to produce liquid fuels from microalgae. This technology is being initially developed for the desert Southwest. As part of this program an outdoor test facility has been designed and constructed in Roswell, New Mexico. The site has a large existing infrastructure, a suitable climate, and abundant saline groundwater. This facility will be used to evaluate productivity of microalgae strains and conduct large-scale experiments to increase biomass productivity while decreasing production costs. Six 3-m² fiberglass raceways were constructed. Several microalgae strains were screened for growth, one of which had a short-term productivity rate of greater than 50 g dry wt m/sup {minus/2} d/sup {minus/1}. Two large-scale, 0.1-ha raceways have also been built. These are being used to evaluate the performance trade-offs between low-cost earthen liners and higher cost plastic liners. A series of hydraulic measurements is also being carried out to evaluate future improved pond designs. Future plans include a 0.5-ha pond, which will be built in approximately 2 years to test a scaled-up system. This unique facility will be available to other researchers and industry for studies on microalgae productivity. 6 refs., 9 figs., 1 tab.

35992 **(SLU-IVL—188) Large scale seasonal storage of tree fuel project. Summary of phase 1.** Thoernqvist, T. (Swedish Univ. of Agricultural Sciences, Uppsala. Dept. of Forest Products). 1986. 61p. (In Swedish). NTIS (US Sales Only), PC A04. Order Number DE88753336/JAW.

In the first phase chipped logging residues and chipped oak trunks were stored in 7 m high piles. The experiment covers eight treatments where the piles are stored for seven months both under cover and in the open as well as compacted and uncompacted. The results showed a moderate increase of the CO/sub2/-content in piles of oak chips. In uncompacted piles with logging residues the CO/sub2/-content rapidly rose to 20% and then slowly decreased. In compacted piles with logging residues the CO/sub2/-content remained between 15-20% throughout the storage period. The temperature in the piles with oak chips was about 10 degrees C above the temperature of the ambient air throughout the experimental period. In the piles with chipped logging residues the temperature was in the 60-100 degrees C range. However, during a three-week period temperatures above 300 degrees C were noted in the central lower parts of the compacted piles with chipped logging residues stored under cover. The moisture content in oak chips was about 36% at the start of the experiment and, as means, about 33% in piles stored outdoors and 24 and 28% respectively in piles stored under cover. The mean moisture content in the piles with chipped logging residues was between 40 and 46% at the start of the experiment. During the storage period the mean moisture content decreased to 23% in the pile stored uncompacted under cover and to 28% for the uncompacted piles in the open. The uncompacted oak chips showed a 3% increase in energy during storage whereas the other material showed energy losses of between 0 and 12%. The conclusion of the experiment was that chipped oak can be successfully stored in 7 m high piles for 7 months. It was also found that there is good economy in seasonal storage of chipped tree fuel.

35993 **(SLU-IVL-U—161) Preliminary results on chemical composition changes in stored forest fuels.** Jirjis, R.; Theander, O. (Statens Energiverk, Stockholm (Sweden)). 1986. 31p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752936/JAW.

The storage effect on the chemical composition of two types of fuel chips: forest residue and oak wood chips was investigated. The chips was stored in two piles, one indoors and the other outdoors. In each pile the chips was stored in two forms: compacted and uncompacted. Samples were taken from 10 defined points and analysed for cellulose, hemicellulose, Klason lignin and ash contents before and after seven months storage. Analyses of the main fractions of indoor stored forest residue showed that carbohydrates were more affected by storage than lignin. Wood and twigs fractions were the least affected by storage. The high temperature which developed in the compacted section was probably mainly responsible for degradation of the polysaccharides. Test points close to the surface of the section exhibited slight changes in the ratio of lignin/carbohydrates while central points, where the temperature reached up to 300 degrees C, showed clear increase in the lignin/carbohydrate ratio. The uncompacted section, stored indoors, showed similar results to those of the compacted section except for the wood fraction where at certain points the lignin/carbohydrate ratio declined after uncompacted storage. In the outdoor stored chips (compacted section) the ratio of lignin carbohydrate was increased in the needles and the bark. Uncompacted storage effect on needles and bark fractions was similar to that of compacted storage. Twig fractions in uncompacted storage changed insignificantly but the wood fraction showed consistently a lower lignin/carbohydrate ratio after storage at all the test points. The chemical composition of compacted and uncompacted oak wood chips was not significantly altered after seven months indoor or outdoor storage. Ash content in stored chips differed slightly from that of fresh chips. (authors).

35994 **(SLU-IVL-U—163) Spontaneous combustion in piles with comminuted wood fuel.** Thoernqvist, T. (Swedish Univ. of Agricultural Sciences, Uppsala). 1987. 26p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752937/JAW.

This report was prepared in order to summarize experiences of thirteen fires breaking out in piles of comminuted wood fuel. The method used was to interview by telephone representatives of the companies involved in order to obtain an opinion on the size of the spontaneously combusted piles and the composition of the material in the pile as well as the expenses involved as a result of the fire. In addition, the reason for the spontaneous self-ignition has also been analysed. The fuel volume in the thirteen piles which combusted during 1986/ 87 varied between 3000 and 93000 m/sp3/. The fires caused fuel losses ranging between 30 and 48000 m/sp3/ in the different piles. In six of the piles the losses ranged between 2500 and 6000 m/sp3/ wood fuel. The costs involved varied between 6000 SEK and 5.3 MSEK. In nine of the fires the costs were in the range from 100000 to 850000 SEK. The cause of the fires can probably be found in the different permeability in various parts of the piles. This assumption is supported by the fact that most of the

fires originated in the border area between different assortments of wood fuel or in the border area between compacted and uncompacted fuel. In two cases the centres of the outbreaks were localized to areas containing objects. In these cases the metal has been assumed to function as a catalyst. Recommendations for storage of comminuted wood fuel are given in the report.

35995 **(STEV-EO—87-4) Large scale experiments South - energy forest cultivation at southern Scania. Progress report.** Perman, G. (Statens Energiverk, Stockholm (Sweden)). Jan 1987. 29p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752946/JAW.

During this period the profitability of energy forestry has been evaluated. The production cost for energy forest chips is about 40 percent higher than that of forest residues. During the autumn we have observed severe damages of stemcancer in the plantations. We have also observed that the roots in the older forest plantations (three years) damage the drainage system in the soil. Through more effective harvest technique and planting material the energy forest can be profitable in the future.

35996 **(STEV-EO—87-5) Large-scale experiments South - energy forest cultivation at southern Scania. Progress report stage 4.** Perman, G. (Statens Energiverk, Stockholm (Sweden)). May 1987. 39p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752947/JAW.

The experience from the energy forest project shows that the economy today is not equivalent to traditional corn production. To achieve this better planting material and more effective harvest and chipping technique is necessary. This winter around 20 hectares have been harvested and chipped. The technique has functioned well but is not yet commercial. Burning tests at Simrishamn (4 MW) and at Hoegesta AB (500 kW) have given good results. The discussion about the surplus situation of the traditional corn production motivates increased efforts in energy forestry development.

35997 **(STEV-FGT—87-3) Gasification in circulating fluidized bed - gasification of crude bark, introductory tests with RDF and gas purification at bench-scale. Studsvik CFBG, Stage 2.** Ekstroem, C.; Blackadder, W. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). Mar 1987. 31p. (In Swedish). (STUDSVIK-EP—87-18). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752958/JAW.

The gasifier has been operated at pilot-scale and it exhibited a constant and very stable service. The quality of the gas was acceptable for the reburning kiln and the availability was high. Bench-scale tests of gas purification have been made with chips, dissociation of char and and NHsub(3) and absorption of Cl for a mixture of chips and PVC have been performed. Various RDF fractions have been used as fuel feed and the handling system has been tested.(GB).

35998 **(STEV-FGT—88-1) Peat - bio - gasification. Final report of stage 8.** Sjoestroem, K. (Statens Energiverk, Stockholm (Sweden)). 12 Nov 1987. 299p. (In Swedish). NTIS (US Sales Only), PC A13. Order Number DE88753340/JAW.

Work has continued with the demonstration units (LDU and LRU) including the new pressurized flash pyrolysis plant. Gasification of biomass fuel is being studied and the reactivity of char is investigated. The formation of tar during pyrolysis is characterized and its decomposition by means of dolomite has been performed. Sintering of catalysts has been observed. Simulation of gasification in fluidized beds has been performed. Mathematical models and their computer programs for combustion, catalysis, fluidized beds etc are presented. (G.B.).

35999 **(STU—82-3556) Example of energy conservation in greenhouses. Heat storage from day to night .** Gefvert, M.; Kjaerboe, P. (Swedish National Board for Technical Development, Stockholm). 28 Apr 1985. 12p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752974/JAW.

The report describes a system for daily storage/discharge of heat. The system is designed to catch as large a fraction as possible of the solar heat, while still offering an acceptable greenhouse climate. The system can be retrofitted to existing greenhouses.

36000 **(SU/FE—ENFOR51984) Nutrient cycling in willow.** Ericsson, T. (Environnement Canada, Ottawa, Ontario. Conservation et Protection). 1984. 32p. (CE—01460). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objectives of this paper were to summarize the state of knowledge regarding nutrient cycling in willow (Salix) plantations managed for energy purposes, identify the major gaps, and recommend further research. Nutrient requirements of intensively-managed willow plantations are high since production may range from 10 to 30 tonnes of stem biomass per hectare per year on fertile soils. The associated nitrogen required by plants to sustain such yields amounts to 200 to 600 kg per hectare when plantations are managed on one-year rotations. The production of stem biomass per unit of nitrogen taken up can be almost doubled by extending rotations longer than two years. Fertilizer requirements are highly dependent on the nutrient status of the soil and the microorganism activity. The need for fertilizers is also influenced by the choice of species, method of culture, frequency of harvest, and degree of plant utilization. The removal of nitrogen in the harvested stem biomass is from 3 to 8 kg per tonne; the lower value corresponds to harvest cycles longer than two years. Nutrient losses due to leaching will probably be small because of the perennial root system, provided that fertilizer is not applied in large doses. 61 refs., 13 figs., 12 tabs.

36001 **(TFB—1981) Biotechnology: a development plan for Canada.** (Task Force on Biotechnology, Ottawa, Ontario (Canada)). 1981. 51p. (CE—01441). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The prospects for future industrial growth in Canada will depend primarily upon the pathways chosen for expanded economic development. One such pathway relates to the growth and development of high technology industries. One new area of high technology which offers significant opportunities for Canada is biotechnology. Biotechnology offers the opportunity to develop new industries as well as to revitalize established ones by the use of processes which, in the production of new or existing products, require significantly less energy than existing ones. For Canada the application of biotechnology to nitrogen fixation, novel aspects of cellulose utilization, the development of plant strains, the treatment and utilization of wastes and mineral leaching are major priorities for industrial development. Canada's current biotechnological efforts are characterized by a wide scattering of research activity in university and government laboratories and the absence of any major industrial activity. Therefore, a major effort is required to stimulate the growth of an industrial sector based upon biotechnology, and at the same time to promote a focussing of the country's research efforts in this area. In this regard, a long-term National Biotechnology Development Plan for Canada is proposed. This plan has eight elements which are the basis for recommendations made in this report. 1 fig.

36002 **(TYOT-JULK—292) Risk analysis of cutting work of the forest owners working in their own forests.** Maekijaervie, L.; Ihonen, M. (Tyotehoseuran Julkaisuja, Helsinki (Finland)). Dec 1986. 67p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752868/JAW.

This study, made at the Forestry Department of the Work Efficiency Association, is part of the joint Nordic project of the Nordic Research Council on Forest Operations (NSR) "The work environment of self employed owners" which was realized in the years 1984-86. The aim of the study was to adapt risk analysis based on video techniques for the cutting work, and evaluate the suitability of the method for investigation of cutting work. By means of the risk analysis, the number and causes of risk situations

of the forest owners and the members of the comparison group were found out in various operations and parts of the work. The comparison group consisted of seven forestry students who had had some training in cutting work. Thus the influence of training in cutting work on the risk situations was studied. The number of risk situations, found in the analysis, was compared with the accidents occurred and the reasons for differences were examined. On the basis of the results, proposals were made for the improvement of work safety.

36003 Specular $CuInSe_2$ films for solar cells. Birkmire, R.W.; McCandless, B.E. (Institute of Energy Conversion, University of Delaware, Newark, Delaware 19716). *Applied Physics Letters;* **53**: No. 2, 140-141(11 Jul 1988).

Specular $CuInSe_2$ films suitable for solar cell devices have been produced by etching the as-deposited films in an aqueous bromine solution. Structural analysis and device results indicate that the $CuInSe_2$ films are compositionally and electronically homogeneous even though the films are deposited in two distinct layers. The implications for improvements in $CuInSe_2$ cell and module performance are discussed.

36004 Positron annihilation spectroscopy of AlGaAs/GaAs interfaces in metalorganic chemical vapor deposition grown GaAs heterojunction solar cells. DeWald, A.B.; Frost, R.L.; Ringel, S.A.; Schaffer, J.P.; Rohatgi, A.; Nielsen, B.; Lynn, K.G. (Georgia Institute of Technology, Atlanta, Georgia 30332). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 4, 2248-2252(Jul 1988).

The defect density profile of high-efficiency epitaxial metalorganic chemical vapor deposition (MOCVD) grown GaAs heterojunction solar cell structures has been characterized using a variable-energy positron beam. Spatial defect changes, film thickness variations, and possibly interfacial space charge and disorder may be resolved from annihilation characteristics by control of the implantation depth of positrons. Correlations were made relating positron annihilation spectroscopy (PAS) measurements to surface photovoltage data, band bending, and known MOCVD growth parameter variations. Based upon these correlations, it is expected that PAS may provide a valuable means for probing defect profiles that may affect the electrical and optical response of MOCVD-grown semiconductor materials.

36005 Effects of heavy impurity doping on electron injection in p^+-n GaAs diodes. Klausmeier-Brown, M.E.; Lundstrom, M.S.; Melloch, M.R.; Tobin, S.P. (School of Electrical Engineering, Purdue University, West Lafayette, Indiana 47907). *Applied Physics Letters;* **52**: No. 26, 2255-2257(27 Jun 1988).

Measurements of electron injection currents in p^+-n diodes are presented for a range of p-type dopant concentrations. A successive etch technique was used to characterize the electron injection current in terms of the product (n/sub o/D/sub n/). Measurements are presented for Zn-doped GaAs solar cells with p-layer hole concentrations in the range 6.3×10^{17}-1.3×10^{19} cm^{-3}. The results demonstrate that so-called band-gap narrowing effects substantially increase the injected electron current in heavily doped p-type GaAs. These heavy doping effects must be accounted for in the modeling and design of GaAs solar cells and heterostructure bipolar transistors.

36006 Binding of hydroxylamine to the water-oxidizing complex and the ferroquinone electron acceptor of spinach photosystem II. Sivaraja, M.; Dismukes, G.C.;. (Princeton Univ., NJ (USA)). *Biochemistry;* **27**: No. 9, 3467-3475(3 May 1988). Contract FG02-84CH10199.

The reaction between spinach photosystem II (PSII) membranes and hydroxylamine has been investigated by equilibrium titrations and flash-induced reactions with electron paramagnetic resonance (EPR) spectroscopy to monitor the odd-electron species, O_2 evolution rate, and manganese binding. Two high-affinity sites for NH_2OH reaction have been characterized. Binding to the first site occurs within the water-oxidizing complex (WOC) and produces the well-known two flash shift in O_2 evolution. The usual two-electron shift in O_2 yield is accompanied by a parallel two-electron shift in the yield of the S_2 multiline EPR signal. The two flash delay in turnover seen at room temperature is lost at low temperatures (150-500 K) due to a block in multiple turnovers caused by NH_2OH. The site for the low-temperature blockage is undetermined but correlates with the structural change at the ferroquinone site. This suggests that the reoxidation of Q/sub A/$^-$ by Q/sub B/ following turnover is blocked, resulting instead in recombination upon warming. The reversible loss of both of the S_2-state EPR signals, the multiline and the g = 4.1 signals, caused by NH_2OH, titrated with identical curves, suggesting a common chemical reactivity and hence origin for these signals. The reaction between the S_2 state and NH_2OH occurs in less than 10 s and is considerably faster than binding to the (dark) SV3! state. The reversible binding of NH_2OH produces no stable paramagnetic products in the dark. The release of MN by NO_2OH is followed by reduction of the oxidized donor D^+ responsible for EPR signal II/sub slow/ and signal II/sub dark/, confirming earlier work establishing the accessibility of this donor to the aqueous phase through the Mn binding site.

36007 Experiments and analysis on the molten salt direct absorption receiver concept. Bohn, M.S.; Wang, K.Y. (Solar Energy Research Institute, Golden, CO 80401 (US)). *Journal of Solar Energy Engineering;* **110**: No. 1, 45-51(Feb 1988).

This paper presents results of experiments on the Direct Absorption Receiver (DAR) concept using molten salt as the working fluid. The DAR concept may result in a solar central receiver that costs 50 percent less than the current tube receiver and has significantly lower operational and maintenance costs. These experiments were aimed at determining whether the DAR concept is technically feasible. Results are based on several days of operating with solar flux ranging up to 50 Wcm^2 and also on a numerical model that is capable of predicting the thermal performance of the DAR salt film. Issues relating to thermal efficiency, absorber-to-salt heat transfer, and salt film stability are addressed.

36008 Photoinitiated charge separation in a carotenoid-porphyrin-diquinone tetra: enhanced quantum yields via multistep electron transfers. Gust, D.; Moore, T.A.; Moore, A.L.; Barrett, D.; Harding, L.O.; Makings, L.R.; Liddell, P.A.; De Schryver, F.C.; Van der Auweraer, M.; Bensasson, R.; Rougee, M. (Arizona State Univ., Tempe (USA)). *Journal of the American Chemical Society;* **110**: No. 1, 321-323(6 Jan 1988). Contract FG02-87ER13791.

Photosynthesis converts light to chemical potential energy in the form of long-lived charge separation across a bilayer membrane. Recombination of the charge-separated state is prevented by the large distance between the final electron donor and acceptor. Because the quantum yield of a single long-range electron transfer across the bilayer would be vanishingly small, reaction centers employ a series of electron-transfer steps, each of which occurs over a short distance with high yield. Synthetic carotenoid-porphyrin-quinone triad molecules and other molecular systems which begin to model this approach have recently been reported. In photosynthetic bacteria, the charge separation sequence includes electron donation from a bacteriopheophytin to a quinone which then transfers an electron to a second quinone. An elegant molecule that models such electron transfer has been prepared, although it did not reproduce the long-lived charge separation characteristic of the natural system. The authors now report the synthesis of a tetrachromophoric molecule 1 consisting of a porphyrin (P) covalently linked to both a carotenoid polyene (C) and a rigid diquinone moiety (Q/sub A/-Q/sub B/), excitation of which produces a long-lived (460 ns in dichloromethane, 4 μs in acetonitrile charge-separated state C/sup .+/-P-Q/sub A/-Q/sub B/$^{\bullet-}$ with a quantum yield of 0.23 at ambient temperatures and 0.50 at 240 K.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 36473, 38015

36009 **(DOE/AL/38869—T2) Photovoltaics for rural electrification in the Dominican Republic.** Hansen, R.D.; Martin, J.G. (Enersol Associates, Inc., Somerville, MA (USA); Lowell Univ., MA (USA)). 21 Aug 1987. Contract FG04-86AL38869. 150p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88007915/JAW.

Enersol Associates, Inc., has begun to structure a program for the introduction of photovoltaics in rural areas, and started to refer to this as the SOBASEC (SOlar-BASed Rural Electrification Concept) program. Throughout the report we have used the acronym SOBASEC to refer to the specific approach to electrification in rural areas with photovoltaics, as developed by Enersol Associates, Inc. This report documents the efforts to date and describes SOBASEC so that a variety of readers may benefit. This report provides an overall background on the Dominican Republic and a history of the project developed by Enersol in the Puerto Plata region. It describes the electric grid system that is owned and operated by the Dominican Government, and which serves urban dwellers and approximately 30% of the rural population. This paper is dedicated to describing the technical and institutional details of SOBASEC as developed by experience in implementing the program and installing the first 100 PV systems. Also discussed is the logical expansion that can take place with adequate financing and institutional support. This is done by describing a reasonable investment scenario. A key catalytic role of this financing is placed in the hands of the organizations that aim toward economic and social development in less developed countries. Recommendations and concluding comments on where this all may lead in the years to come is finally discussed. 61 refs., 59 figs.

36010 **(SERI/PR—211-3299) Photovoltaic Program Branch: Annual report, FY 1987.** (Solar Energy Research Inst., Golden, CO (USA)). Mar 1988. Contract AC02-83CH10093. 310p. NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88001155/JAW.

The PV Program Branch of the Solar Energy Research Institute (SERI) is responsible for managing the subcontracted portion of SERI's Photovoltaic Advanced Research and Development (PV AR&D) Project. In fiscal year (FY) 1987, this included more than 65 subcontracts, with a total annualized funding of approximately $15.7 million. Research was conducted in the following task areas: the Amorphous Silicon Research Project, Polycrystalline Thin Films, Crystalline Silicon Materials Research, High-Efficiency Concepts, the New Ideas Program, and the University Participation Program. The major portion of FY 1987's subcontracted research resulted from awards under six competitive solicitations initiated in FY 1986. 278 refs.

36011 **Utility application of photovoltaic power generation: A survey of recent literature.** Sugimura, R.S.; Wood, J.M. (Jet Propulsion Lab., Pasadena, CA 91109 (US)). *IEEE Transactions on Energy Conversion;* **EC-2**: No. 4, 563-569(Dec 1987).

A bibliography of recent documents on the subject of photovoltaic power generation for utility application is presented. The bibliography is divided into two subject areas: central station systems; and residential/intermediate systems.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 36044, 36047, 36699, 36792

36012 **(CONF-880282—1) Phase change problem related to thermal energy storage in the manned space station.** Wilson, D.G.; Drake, J.B.; Flanery, R.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011390/JAW.

From Institute for Mathematics and its Applications seminar; Minneapolis, MN, USA (23 Feb 1988).

The system discussed consists of a solar collector lined with small metal canisters filled with a high temperature phase change material (PCM), lithium fluoride salt. The canisters are small enough to fit comfortably in the palm of one's hand and there are a hundred or more of them. A heat transfer fluid, an inert gas such as helium or neon, circulates through the pipes that pass through the metal canisters and carries heat away to turbines, generators, etc. The continual melting and refreezing of the PCM smears out the delivery of the solar energy to the transfer fluid, and hence, to the heat engines beyond. The motivation for using a PCM based thermal energy storage system is that a properly sized such system can store and deliver energy over a narrow temperature range near the melting point of the PCM, thus avoiding extreme temperature variations.

36013 **(PNL—6129) Solar thermal bowl concepts and economic comparisons for electricity generation.** Williams, T.A.; Dirks, J.A.; Brown, D.R.; Antoniak, Z.I.; Allemann, R.T.; Coomes, E.P.; Craig, S.N.; Drost, M.K.; Humphreys, K.K.; Nomura, K.K. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 256p. NTIS, PC A12/MF A01;1; GPO Dep. Order Number DE88009236/JAW.

This study is aimed at providing a relative comparison of the thermodynamic and economic performance in electric applications for fixed mirror distributed focus (FMDF) solar thermal concepts which have been studied and developed in the DOE solar thermal program. Following the completion of earlier systems comparison studies in the late 1970's there have been a number of years of progress in solar thermal technology. This progress includes developing new solar components, improving component and system design details, constructing working systems, and collecting operating data on the systems. This study povides an update of the expected performance and cost of the major components, and an overall system energy cost for the FMDDF concepts evaluated. The projections in this study are for the late 1990's and are based on the potential capabilities that might be achieved with further technology development.

36014 **(SAND—87-2886C) Optical evaluation of prototype stretched - membrane mirror modules for solar central receivers.** Alpert, D.J.; Houser, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880655—4). NTIS, PC A02/ MF A01; 1; GPO Dep. Order Number DE88011884/JAW.

From 4. international symposium on research, development and applications of solar thermal technology; Santa Fe, NM, USA (13 Jun 1988).

Under contract to Sandia National Laboratories, two independent studies were performed to develop a commercial-scale heliostat design and to assess the fabrication and costs of stretched-membrane heliostats. The studies, performed by Solar Kinetics, Inc., and Science Applications International Corp., concluded that stretched-membrane heliostats would cost between 15% and 20% less than comparable glass-mirror designs. As part of these studies, 50-square-meter prototype mirror modules were built and installed for testing at the Central Receiver Test Facility (CRTR) at Sandia. Major issues addressed in our testing program included the optical performance of the stretched-membrane mirror, the performance of the mirror's focus-control system in windy conditions, the performance of the defocus system, and the durability of the reflective film. The results of the evaluation indicate that the optical performance of SKI's first-of-a-kind mirror module is at least as good as that of current glass-mirror designs. In calm conditions, the mirror can be defocused to a convex focal length of -200 meters in 7 seconds. The optical performance on windy days is within Sandia's heliostat specifications. After 2 years of exposure, the reflective surface was generally in good condition, having a clean reflectivity of nearly 90%.

36015 (SAND—87-2910C) **Performance evaluation of large-area glass-mirror heliostats.** Alpert, D.J.; Houser, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880655—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011883/JAW.

From 4. international symposium on research, development and applications of solar thermal technology; Santa Fe, NM, USA (13 Jun 1988).

Heliostats using glass-mirror reflectors have been built in sizes up to 200 square meters. These large-area heliostats are over three times bigger than second-generation heliostats and represent the culmination of DOE's second-generation heliostat development program. Using larger heliostats provides economies of scale resulting in lower costs per unit area. There is, however, a penalty in optical performance with using large-area heliostats. In addition, because of their size, large heliostats are more difficult to clean and could be more prone to damage by wind loading. To address these concerns, Sandia National Laboratories purchased two large-area heliostats, one from Advanced Thermal Systems (ATS) and the other from Solar Power Engineering Co. (SPECO), with reflective areas of 150 and 200 square meters, respectively. Both incorporate design improvements that were suggested but not employed during previous development programs. The heliostats were installed at the Central Receiver Test Facility (CRTF) for Sandia to test and evaluate. Tests were designed to provide a basis for comparing the performance of the heliostats against Sandia's specifications for optical performance and structural integrity. Specific issues addressed included: (1) quality of the reflective beam, (2) performance of the tracking and heliostat control system, (3) quality and pointing accuracy of the beam under wind loads, (4) efficacy of alternative methods for cleaning the mirrors, and (5) long-term durability of the mirror, drives, and support structure.

36016 **(SAND—87-2976C) Reflux heat-pipe solar receivers for dish-electric systems.** Andraka, C.E.; Diver, R.B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 14p. (CONF-880702—1). NTIS, PC A03;3. Order Number DE88008671/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

The feasibility of competitive, modular bulk electric power from the sun may be greatly enhanced by the use of a reflux heat pipe receiver to combine a heat engine with a paraboloidal dish concentrator. This combination represents a potential improvement over previous successful demonstrations of dish-electric technology in terms of enhanced performance, lower cost, longer life, and greater flexibility in engine design. In the reflux (i.e. gravity assisted) heat pipe receiver, concentrated solar radiation causes liquid metal (sodium, potassium, or NaK) to evaporate. The vapor flows to the engine interface heat exchanger, where it condenses and releases the latent heat. The condensate is returned to the receiver absorber by gravity (refluxing), and distributed over the surface by gravity and/or capillary forces in a wick lining the receiver. It is essentially an adaptation of heat pipe technology to the peculiar requirements of concentrated solar flux, and provides many advantages over conventional heated tub receiver technology. This overview paper describes the current status and future plans for the US Solar Thermal Program reflux receiver development program at Sandia National Laboratories. Current work includes conventional mesh wick receivers, sintered metal wicks, and pool boiler receivers. The relative design merits and concerns of the different approaches and technology development test plans are discussed.

36017 **Closed loop thermochemical energy transport based on CO/sub 2/ reforming of methane: Balancing the reaction systems.** Fish, J.D.; Hawn, D.C. (Process Research Div., 6254, Sandia National Labs., Albuquerque, NM (US)). *Journal of Solar Energy Engineering;* **109**: No. 3, 215-220(Aug 1987).

The objective of the Closed Loop Efficiency Analysis (CLEA) Project at Sandia National Laboratories is to develop the data base, the calculational tools, and the operational experience necessary for the design of cost-effective energy transport systems based on reversible chemical reactions. The primary application of interest is the transport of solar energy either from the collectors of a distributed system to a central site or from a solar energy plant of any type located in an area of high solar insolation to a population or industrial center a few to several hundred kilometers away. A series of experiments and analysis have been carried out to explore the effect of catalyst selection, starting composition, reactor temperatures, system pressure, and water recycle on the operation and the efficiency of an energy transport-system based on the reversible carbon dioxide reforming of methane. Both the experiments in the CLEA laboratory facility and the analyses indicate that the carbon dioxide/methane thermochemical energy transport system can be operated in a stable, closed-loop mode and that the system can be started up and shut down, as it must be daily in a solar application, without triggering either catastrophic instabilities or carbon deposition. Based on the success of the CLEA project, two new hardware projects have been initiated to address scale-up and direct solar interfacing.

36018 **Receiver/reactor concepts for thermochemical transport of solar energy.** Diver, R.B. (Sandia National Labs., Albuquerque, NM (US)). *Journal of Solar Energy Engineering;* **109**: No. 3, 199-204(Aug 1987).

Thermochemical transport of solar energy based on reversible chemical reactions may be a way to take advantage of the high-temperature capabilities of parabolic dishes, while minimizing pipe network heat loss, since energy is transported at ambient temperatures in chemical form. Receiver/Reactor design is a key to making thermochemical transport a reality. In this paper the important parameters for solar receiver and chemical reactor design and how they relate to each other are presented. Three basic receiver/reactor types, applicable to thermochemical receiver design, are identified: (1) Tube Receiver/Reactors have tubular reactor elements which are directly heated by solar energy in the receiver. (2) Indirect Receiver/Reactors use an intermediate heat transfer fluid between the receiver and reactor. (3) Direct Absorption Receiver/Reaxtors absorb sunlight directly on the reactor catalyst. Advantages, limitations, and risks associated with each design are discussed and examples of those that have been built are given. Each type offers its own set of advantages and risks, and warrant further investigation.

36019 **Energy and availability transport losses in a point-focus solar concentrator field.** Stine, W.B.; Heckes, A.A. (Mechanical Engineering Dept., California State Polytechnic Univ., Pomona, CA (US)). *Journal of Solar Energy Engineering;* **109**: No. 3, 205-209(Aug 1987).

This paper presents the results of an experimental study of the losses in transporting thermal energy from a field of 114 point-focus solar collectors to a central thermal energy conversion system at the Solar Total Energy Project (STEP), Shenandoah, Georgia. Conduction and convection heat losses from the collector field piping and solar collector receivers and radiant energy losses from the solar collector receivers were measured. At normal operating conditions the steady state heat losses per unit of collector aperture area are 130 W/m/sup 2/ (41 Btu/hr-ft/sup 2/). The thermal mass of the collector field was found to be 3.92 KWh/°C (7,440Btu/°F), which implies that 17 percent of the energy collected on a typical day is used to warm the field piping to its operating temperature. The loss of availability from the collectors and the field piping shows that only 21 percent of the available solar energy falling on the collector field is delivered to the power cycle for conversion into electricity.

36020 **Performance/economics comparison of sensible and thermochemical energy transport systems for solar thermal dish applications.** Muir, J.F. (Sandia National Labs., Albuquerque, NM (US)). *Journal of Solar Energy Engineering;* **109**: No. 3, 227-234(Aug 1987).

A major challenge facing the development of distributed receiver solar systems is the efficient transport of high temperature thermal energy from the collectors to the point of use. As receiver temperatures increase, conventional sensible (SEN) energy transport methods become less attractive because of increased heat losses and insulation costs. A promising alternative that is particularly attractive for the high temperatures characteristic of paraboloidal dishes and the extensive piping associated with large collector fields is the concept of thermochemical (TC) energy transport. Estimates of the performance and economics of 4 SEN and 2TC transport systems for a dish collector field are compared at 4 delivery temperatures ranging from 400 to 815°C. On the basis of levelized energy cost (LEC), there is no clear choice between SEN and TC energy transport at 400°C. At higher output temperatures, TC transport is more cost-effective and is the only viable choice at tem-

peratures above —700°C. The TC system based on the carbon-dioxide reforming of methane has the best performance and lowest costs at temperatures >400°C and appears closest to meeting the DOE Solar Thermal Technology (STT) Program long-term IPH goal of 3 cents/kWH/sub th/ (9$/MBtu/sub th/) LEC.

36021 **Direct absorption receiver system for high temperature.** West, R.E. (Dept. of Chemical Engineering, Univ. of Colorado, Boulder, CO (US)). pp 361-373 of Solar energy utilization. Yuncu, H.; Paykoc, E.; Yener, Y. Hingham, MA; Martinus Nujhoff Publishing (1987). (CONF-8606348—).

From Solar energy utilization; Izmir, Turkey (23 Jun 1986).

A design study for a 900°C, direct absorption, solar central receiver concept has been performed. The eutectic mixture of sodium, potassium, and lithium carbonates was the heat absorbing fluid. This molten salt has several desired properties but is corrosive at 900°C, so that finding suitable materials of construction is one of the key problems in developing this technique. Such research, development, and design issues as flow and heat-transfer characteristics of the film, cavity layout, and downcomer piping design are discussed. The overall performance of the system has been predicted, based on current knowledge, and these results are presented.

36022 **Thermochemical energy transport for solar thermal dish applications: Component analysis.** Reilly, H.E. (Sandia National Labs., Albuquerque, NM 87185 (US)). pp 1728-1732 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC04-76DP00789.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879335.

Thermochemical energy transport has been proposed as a means to reduce the energy losses associated with delivering solar energy from a field of solar receivers to a central use point. This paper presents an analysis of the recuperative heat exchangers that would be used in a field of solar parabolic dish collectors interconnected by a thermochemical transport system. The thermochemical system analyzed is the carbon dioxide reforming of methane. These system analyses are being performed in conjunction with the design and construction of the Closed Loop Operations Experiment (CLOE), a field-scale CO_2CH_4 thermochemical transport experiment to demonstrate the viability of the concept. The scope of this effort includes a determination of recuperator heat loss as a function of recuperator effectiveness at design conditions; modeling of the recuperator and solar receiver in order to estimate annual recuperator heat loss as a function of effectiveness; and relating recuperator effectiveness and cost.

36023 **Reflux heat-pipe solar receiver for a Stirling dish-electric system.** Ziph, B.; Godett, T.M.; Diver, R.B. (Stirling Thermal Motors, Ann Arbor, MI 48104 (US)). pp 1733-1738 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879402.

The feasibility of competitive, modular bulk electric power from the sun is enhanced by the use of a reflux heat-pipe receiver to combine a Stirling engine with a paraboloidal dish concentrator. This combination represents a potential improvement over previous successful demonstrations of Stirling dish-electric technology in terms of enhanced performance, lower cost, and longer life. In the reflux (i.e. gravity assisted) heat-pipe receiver, concentrated solar radiation causes liquid sodium to evaporate, the vapor flows to the Stirling engine heaters where it condenses on the heater tubes. The condensate is returned to and distributed over the receiver by gravity (refluxing) and by capillary forces in a wick lining the receiver. It is essentially an adaption of sodium heat pipe technology to the peculiar requirements of concentrated solar flux and provides many potential advantages over conventional tube receiver technology. This paper describes the preliminary design of a reflux heat-pipe solar receiver to match the STM4-120 variable swashplate Stirling engine to a Test Bed Concentrator at Sandia National Laboratories Distributed Receiver Test Facility. Performance analysis and other design considerations are presented and discussed.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 36479, 36582, 36591

36024 **(BFR-R—61-1986) Solar heating for detached houses. Domestic hot water heating and space heating.** Ellehauge, K.; Kristensen, P.E.; Hultmark, G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 59p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752884/JAW.

The objective of this work has been to test, at the Lyngby Institute of Technology in Denmark, a solar heating system intended to supply both space heating and domestic hot water for detached houses. A complete system has been built and the energy consumptions of a detached house have been simulated. The basic idea of the system that has been tested is that it should incorporate a technology tank which would be factory built. The tank would have a modest volume, which could then be increased at site as required without needing advanced equipment. The installations has been operated outdoors for a period of seven weeks. Weekly thermal energy balances for the test period are included in the report. Several component and system parameters have been monitored: solar collector efficiency, store losses, interaction between the technology tank and the heat store, efficiency of the heat exchanger and heat transfer between the water in the store and domestic hot water. The report is concluded with a consideration of possible lines of development. (authors).

36025 **(BFR-R—71-1986) Rock heat well with an air heat collector. Field trials of performance and combined power output.** Tollin, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 19p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752887/JAW.

Between August 1984 and August 1985 an older detached house which had been heated by a rock heat source since October 1980 was complemented with a simple air heat collector. The collector has been used to recharge thermal energy into the rock and to serve as a parallel heat source when the heat pump is in operation. The collector is in the form of a cylindrical hose bundle, with an external diameter of 165 cm and a height of 112 cm, made up of 186 m of 25 mm diameter black polyethane hose. Corrugation of the external surface of the hose has increased its area by about 50 percent. During the year in which performance has been monitored, the collector has supplied about 6050 kWh of heat, of which 50 - 75 percent has been supplied to the rock and the reminder has been utilized directly in the heat pump. The collector has not resulted in any significant increase in the temperature of the heat source, or in any improvement in operating economics, during the December-March period. During the reminder of the time, however, the collector has resulted in an increase in temperature of about 1-3 K during the spring and autumn, and of about 4-6 K during the summer. With a single-well system such as this, it is probably generally more cost-effective to invest the money in deepening the well instead of installing an air heat collector.

36026 **(BMFT-FB-T—86-215) Application-oriented studies of evacuated tubular collectors. Final report.** Schreitmueller, K.; Reitz, H.J.; Rockendorf, G.; Vanoli, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 194p. (In German). NTIS (US Sales Only), PC A09. Order Number DE88752639/JAW.

The operational behaviour of evacuated tubular collector (ETC) systems is fairly well known up to temperatures of appr. 90degC. However, for know-how and technology transfer and in order to extrapolate to higher temperatures both experimental investigations of the involved components and systems and the development of user-friendly design methods are necessary. The thermal losses of several types of ETC have been measured with absorber temperatures of up to 300degC and possible degradations investigated. Of special interest for the envisaged test facility for solar indus-

trial process heat are the investigations of the dynamic processes within the collector fields and storage tanks. A design method, basing on analytically determined input-/output-diagrams, and which may be applied both to DHW, IPH, and district heating systems, is presented. Finally, the proposal for a short-time test method for solar DHW systems is presented. The results show clearly the high importance of ETC (with or without CPC) in the 60...200degC temperature range. With 45 refs., 6 tabs., 76 figs..

36027 (EMR—EMR12) Catalogue of solar heating products and services in Canada. Argue, R. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Renewable Energy Resources Branch). Feb 1977. 112p. (CE—01494). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This catalogue is an attempt to identify the private sector's activity in the solar heating field in Canada. Over one hunderd and fifteen individuals and businesses that offer services in solar space heating, solar water heating or solar pool heating are identified. Altogether there are more than fifty companies that manufacture, distribute or will fabricate on-site solar heating systems and components. Of these, one third offer off-the-shelf units which they manufacture in Canada. Another third distribute components imported into Canada, mainly from the U.S. More than twenty design companies supply or manufacture on-site solar heating equipment. Roughly seventy companies are listed which supply engineering or architectural design services or information for solar heating of buildings. The introduction outlines the principles of the various basic types of solar heating systems, their applicability to Canada, and calculations of their economic benefit. A bibliography of books and periodicals related to solar heating is included. 40 figs.

36028 (EUR—9913-FR) Conception, construction and in-situ testing of a cold store powered with solar energy using a zeolite-water binary fluid. Conception and construction of a solar powered ice-maker using the activated carbon-methanol pair. Final report. Grenier, P.; Guilleminot, J.J.; Meunier, F.; Pons, M. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 63p. (In French). Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energie.

This final report presents results of a study which had two objectives: - test the feasibility of the zeolite-H_2O pair to medium size solar powered cold stores, - find a new pair so as to realize a solar powered ice-maker. The work presented in this report enables us to give some conclusions. The zeolite-water pair allows to build solar powered units ranging from small individual refrigerators (for camping or for vaccine storage) to medium size cold stores. In our study, we did not notice any important size effect between our small units and the 12 m^2 (with 20 m^2 solar collectors) unit. The activated carbon-methanol pair can be used as well as the zeolite-water pair for conservation at +5°C: we think that it is after a value analysis study that a good choice between the two pairs will be possible. But more over, the activated carbon pair can be used to fire a solar powered ice-maker. The scale which seems to be realistic for the application of this pair ranges from very small units to units producing somes hundreds of kilogrammes (or some thousands) of ice per day.

36029 (EUR—10205-EN) European Modelling Group: Solar space heating and domestic hot water systems. Final report. McGrath, E. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 202p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

This report covers the work performed by the UK participants in the European Modelling Group (EMG) from July 1981 to June 1983. Eight countries were involved in this coordinated project. The aim was to develop and test a detailed simulation model capable of predicting the performance of a wide range of solar space heating and domestic hot water systems in a range of climates typical of Europe. This model would bring together each participant's experience with their own simulation models in the previous work of the EMG. Having developed the model it would be used in studies of various systems. At the same time, the available simplified methods would be examined and from these a number would be improved and developed in order to produce a European simplified method.

36030 (EUR—10512-EN) Solar pilot test facility - a powerful tool for model validation and solar system development. Final report. Backer, G. (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation). 1986. 305p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

Although the participants of the European Solar Pilot Test Facility Group (SPTF) have reported the results of their research work individually, it seemed opportune to produce a final report of the Group as a whole. In this final report, to which all the participants of the SPTF-Group have contributed, common aspects of the work of the Group as well as the results of individual experiences are reported. The report shows, as the title says, how powerful this type of facility is for model validation as well as for system development.

36031 (MEM/CRE—061983) Solar heated swimming pool. (Manitoba Dept. of Energy and Mines, Winnipeg (Canada). Conservation and Renewable Energy Branch). Jun 1983. 6p. (CE—01435). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Town of Winkler, Manitoba, received funding to assist in the installation of an active solar water heater for the public swimming pool. Solar heat gain is accomplished by pumping pool water through a 1,525 m (5,000 ft) coil of one-inch black polyethylene plastic pipe. The heated water is then returned to the pool through the filtering system. The design is very simple, low cost and requires minimal maintenance. The town has experienced an approximate 40% reduction in natural gas fuel requirement for heating the pool. This savings would give a simple payback on the $2,200 (1980) cost in about two years. This report describes the Winkler pool heating system and makes some recommendations for improvement of the operation. 3 figs.

36032 (PB—88-183215/XAB) Passive solar commercial buildings: four Norwegian case studies. Hestnes, A.G. (SINTEF, Trondheim (Norway)). 9 Nov 1987. 27p. (STF—62-A87011). NTIS, PC E04/MF E04.

The purpose of the project is to identify exemplary nonresidential buildings with innovative passive solar and daylighting techniques, and to evaluate the performance of these buildings in terms of energy, economy, and function using available data. The report describes the four Norwegian buildings used as case studies in the Passive Solar Commercial Buildings project within the International Energy Agency's Solar Heating and Cooling Program.

36033 (PB—88-183223/XAB) Solar houses at Heimdal: five years of experience. Hestnes, A.G.; Gunnarshaug, J. (SINTEF, Trondheim (Norway)). 13 Nov 1987. 10p. (STF—62-A87012). NTIS, PC E03/MF E03.

This paper describes three solar dwellings built as part of a major research project on energy conservation in Norwegian dwellings - the Heimdal project. The overall objective of the project, which consists of fourteen dwellings, was to demonstrate and evaluate the effect of various energy-conservation measures and the use of alternative energy sources in typical Norwegian single-family dwellings.

36034 (S—SOLWAT5) Development of institutional size pre-engineered solar DHW systems. Swartman, R.K.; Dobbin, W. (Solcan Ltd., London, Ontario (Canada)). May 1983. 41p. (CE—01426). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this work was to develop designs for a series of pre-engineered solar hot water systems suitable for institutional, commercial, and industrial applications. Six common hot water loads between 2,500 and 14,750 liters per day are selected for various institutional applications, including restaurants, schools, and nursing homes. Both F-chart and WATSUN III computer simulations were performed for the systems using the appropriate load profile for each application. The parameter of major interest was the ratio of effective surface area of the solar collector to the heating load. Solar hot water systems were then designed for each load, with 3 collector area options offering 3 different solar contributions for each load. The pre-engineering of the systems included selection of components and the design of freeze protection and other plumbing features. 14 figs., 2 tabs.

36035 Builder guidelines. Balcomb, J.D. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO (US)). pp 403-405 of Proceedings of the 12th passive solar conference. Andrejko, D.A.; Hayes, J. Boulder, CO; American Solar Energy Society (1987). (CONF-870711—).

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

The Builder Guidelines project seeks to provide booklets that will help builders in designing highly energy efficient passive solar houses. The concept follows from the Solar Showcase in New Mexico reported at the 8th Passive Solar Conference. The Guidelines are packaged in two booklets, each about 20 pages long. The first contains performance target levels and design guidance; the second contains computation worksheets and performance tables. Both relate to a specific locality within which the heating or cooling degree days vary by no more than 10%. The techniques for developing target levels for a locality and the worksheet analysis procedure are discussed. These are based on the Los Alamos Solar Load Ratio method, a new simplified cooling load method, and a method of balancing conservation and passive solar that accounts for the summer cooling consequences of the passive design. The background, current status, and future plans of the project are described.

36036 Energy signatures: New results. Lekov, A.; Balcomb, J.D. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO (US)). pp 310-313 of Proceedings of the 12th passive solar conference. Andrejko, D.A.; Hayes, J. Boulder, CO; American Solar Energy Society (1987). (CONF-870711—).

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

Energy signatures is a new instructive design tool for selecting and sizing passive solar elements in a building. This paper extends previous work. The objective function is generalized to include terms for the initial cost of each passive solar element and for future energy cost in addition to the thermal comfort term considered in the previous paper. Optimization equations are given, and a simple example is presented to illustrate the nature of the results.

36037 Thermal performance of advanced glazings: Predictions based on the FSLR method. Christensen, C. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401 (US)). pp 134-139 of Proceedings of the 12th passive solar conference. Andrejko, D.A.; Hayes, J. Boulder, CO; American Solar Energy Society (1987). (CONF-870711—).

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

A simple method is presented for predicting heating performance of nonstandard glazing types in direct gain buildings. The method extends solar load ratio (SLR) calculations by use of modified building and climate parameters to account for nonstandard glazing characteristics. Results are given for a range of glazing types, climates, and building types (conventional, superinsulated, and passive solar). Predicted net energy savings (relative to double glazing) are 30-60 kBtu/ft/sup 2/ yr for glazings with suspended plastic films and low-emittance or, in some cases, antireflectance coatings. Further savings of approximately 10-30 kBtu/ft/sup 2/ yr are possible, particularly for south glazings, with the use of low-iron glass and a low-conductance gas fill. For an evacuated glazing, predicted net energy savings are 60-80 kBtu/ft/sup 2/ yr, superior to all other glazing types analyzed and approximately two to ten times better than other glazing types do not require the use of suspended plastic films.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 36007, 36014, 36015, 36019, 36026, 36027, 36030

36038 (BFR-R—52-1986) Convection suppressing devices in solar collectors. A theoretical and experimental investigation. Loefving, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 30p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752882/JAW.

This report discusses the performance of solar collectors incorporating various types of convection suppressing devices. A model which enables the efficiency graph to be calculated, in terms of both optical and thermal efficiency, is presented. A series of performance measurements that were made by the Swedish Testing Institute of the efficiency of a number of solar collectors fitted with various types of convection suppressing devices, together with measurements made at the Aelvkarleby laboratory of the Swedish State Power Board of the thermal resistance of a simulated solar collector fitted with a greater number of variations of convection suppressing devices, are also presented. The results of the investigation and of the measurements can be briefly summarised as follows: - Using present-day manufacturing methods, classic anti-convection baffles of honeycomb type, and similar baffles, are too expensive to manufacture to be considered for use in solar collectors. - In terms of corrugated thermal resistance, the performance of solar collectors fitted with corrugated films as anti-convection baffles is comparable with that of collectors fitted with one or two flat films. - As reflection losses are lower for a properly corrugated film than for a flat film, collector performance is improved if a film is used compared to one or two flat films.

36039 (PB—88-186390/XAB) Feasibility study of seasonal thermal storage in solar-heating systems for southern climates. Kenisarin, M.M.; Karabaev, M.K.; Lund, P.D. (Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics). 15 Dec 1987. 25p. (TKK-F-A—617). NTIS, PC E03/MF A01.

Numerical computer simulations of solar district-heating plants with seasonal thermal storage for Tashkent conditions are discussed. A water pit is considered as the storage medium. The effects of different collector absorber-surface types and of water-pit top thermal insulation are investigated. Optimum relationships between collector area and storage volume are presented. It is shown that, in southern climates, a solar fraction of 50-60% can be achieved at lowest solar component cost for a central solar heating plant with seasonal thermal storage. A short review of the various basic concepts for seasonal thermal storage is also presented.

36040 (SAND—87-2619C) Heat transfer modeling of the IEA/SSPS [International Energy Agency/Small Solar Power Systems] volumetric receiver. Skocypec, R.D.; Boehm, R.F.; Chavez, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 16p. (CONF-880724—15). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007589/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

A wire-pack volumetric receiver was tested in 1987 in Almeria, Spain, by the International Energy Agency/Small Solar Power Systems (IEA/SSPS). Although the experiment goal was strictly

proof-of-concept and was not receiver characterization, modeling efforts were initiated to help understand the experimental results. The steady-state performance and comparisons to experimental data are presented. The model allows an absorber design to be thermally characterized and optimized based on solar energy transfer characteristics and temperature distributions in the receiver. Model predictions of receiver power and efficiency are generally higher than the test results (operational modifications are believed to have produced nonideal conditions), but trends are consistent with experimental data. 12 refs., 5 figs.

36041 (SAND—87-2875C) Direct absorption receiver flow testing and evaluation. Chavez, J.M.; Tyner, C.E.; Couch, W.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880655—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011914/JAW.

From 4. international symposium on research, development and applications of solar thermal technology; Santa Fe, NM, USA (13 Jun 1988).

Flow testing has been conducted, at lengths up to 10 m, to investigate fluid stability concerns, effects of panel tilt, manifold designs, and control issues in a direct absorption receiver (DAR). The heat-absorbing fluid (a blackened molten nitrate salt) in a DAR flows in a thin, wavy film down a flat panel (rather than through tubes) and absorbs the concentrated solar flux directly. The DAR offers numerous potential performance and economic advantages when compared to a fluid-in-tube receiver for production of electricity. Water flow testing has demonstrated that relatively large waves develop as fluid flows down the panel and that large droplets of water are ejected from wave crests on long vertical panels at high flow rates. Various panel surface treatments and panel tilt have shown potential in reducing wave size and thus the amount of fluid loss. However, even a small amount of fluid loss in unacceptable on a DAR. We have designed and are building a solar panel research experiment (PRE) to conduct salt flow testing and solar DAR characterization. Based on results of the water flow testing, the initial test of the PRE system will be a 10 m-long molten salt flow test to verify the flow characteristics of salt versus those of water. We expect to begin testing in late 1988.

36042 (SAND—88-0234C) Planarization of metal substrates for solar mirrors. Ashley, C.S.; Reed, S.T.; Mahoney, A.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-8804114—4). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011492/JAW.

From Better ceramics through chemistry III; Reno, NV, USA (5 Apr 1988).

The planarizing ability of sol-gel films was investigated on several as-rolled stainless steel substrates. The smoothing effect afforded by the films was evaluated, using optical techniques, following deposition of silver over the planarized substrates. The specular reflectance of various substrates, initially ranging from 0.36 to 0.90, could be improved to final reflectance values of {approximately}0.93 with sol-gel processing. This process is being used to prepare prototype foil mirrors for evaluation in the next generation of solar concentrators.

36043 (SERI/TP—253-3324) Performance sensitivities for point-focus dish systems with secondary concentrators. Lewandowski, A.; O'Gallagher, J. (Solar Energy Research Inst., Golden, CO (USA); Chicago Univ., IL (USA). Enrico Fermi Inst.). Apr 1988. Contract AC02-83CH10093. 7p. (CONF-880615—1). NTIS, PC A02;3. Order Number DE88001152/JAW.

From Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference; Cambridge, MA, USA (18 Jun 1988).

This paper describes an analytical study of several performance--related benefits of using a secondary concentrator in point-focus dish designs. Previous research efforts have shown that design-point performance of dishes can be improved with secondary concentrators, especially for dishes with higher optical errors or at higher receiver operating temperatures. This work addresses the sensitivity to changes in design-point parameter values corresponding to both tracking and optical errors. An anlytical model and a ray-trace model were used in analyzing these sensitivities. Results indicate that properly designed secondaries can significantly increase the tolerance to tracking errors and decrease the sensitivity to changes in optical errors from design-point values. Two approaches are recommended on which to base the design of the secondary. 4 refs., 7 figs.

36044 (SERI/TR—255-3242) Specular steel surfaces for solar mirror substrates. Tracy, C.E.; Gross, G.E. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1988. Contract AC02-83CH10093. 45p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88001153/JAW.

The long-range objective of this task is to develop a process for making a silvered stainless steel mirror that has the optical performance and service life of a silvered glass mirror coupled with the mechanical durablilty, structural strength, and flexibility of sheet steel. Such reflectors are expected to minimize the cost handling, shipping, and fabrication into concentrators. Applications for helistats are assumed to require a lifetime average reflectance of 90% in a full-cone aperture angle of 8 mrad. Specifically, this work is designed to produce thin metal membranes with sufficiently fine surface finishes to serve as substrates for direct silver deposition or indirectly for silvered polymer films or silvered sol-gel coatings in heliostat, parabolic trough, and dish applications. Our focus is on the effect of the sheet metal finish on specularity and the ways to obtain the optimum surface finish by conventional manufacturing processes. This report addresses the relationship of optical quality to surface finish and the results of a cooperative research venture with a commercial sheet manufacturer to produce specular stainless steel surfaces by cold-rolling with highly polished rollers. 14 refs., 13 figs., 4 tabs.

1420 Heat Storage

REFER ALSO TO CITATION(S) 36007, 36039, 36459

36045 (BFR-R—84-1986) Sunclay project. Performance assessment of the Sunclay system: Second generation system design. Graeslund, J.; Hultmark, G.; Olsson, S.; Rudholm, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 146p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752891/JAW.

The Sunclay project is the name given to the heat production system for the Lindaelv school in Kungsbacka, about 30 km south of Goeteborg. Heat is supplied to a secondary school having 800 pupils. The school is a single-storey building, wiwth a floor area of 15000 m/sub2/, incorporatiang facilities for teaching, administration, food preperation, physical recreation, theatre and sparee time activities. Indoor temperatures are maintained constant at + 20 degree C throughout the day. The Sunclay systems involves storage of solar energy from summer to winter in clay. Solar enerrgy is used as the heat source for diesel-driven heat pumps, which supply the school with space heating, ventilation and domestic hot water supplies. This results in a saving of about 60 percent of the oil that would otherwise have been consumed by a conventional oil-fired heating system. The additional cost of the sunclay system amounted to about 3 percent of the total cost of the school. The Sunclay system was started up in April 1981, and operated well after a number of initial breakdowns. The pay-off time is about nine years, which means that is a 20-year life of the equipment is assumed, together with a 4 percent real rate of interest, the cost of the energy produced is about 30 oere/kWh.

36046 (BFR-R—105-1986) Storage of solar heat for an apartment building at high temperatures in clay. An evaluation. Olsson, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 41p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752903/JAW.

The Eksta Housing Foundation has built a number of apartment buildings in Kullavik, having a heating system consisting of roof-integrated solar collectors, a clay heat store, a heat pump and an oil-fired boiler. The objective of the work of this report has been to measure the temperatures and flows in the piping system

and allow evaluation of the performance of both system as a whole and parts of it. Measurements have also been made with the aim of investigating the effects of high temperatures on the clay and on its characteristics. Operating experience after 2.5 years operation is good. No significant breakdowns have occurred, and the system has operated as intended. The energy measurements indicate that the results achieved are largely in accordance with expectations. Oil savings have amounted to 82 percent, as compared to 90 percent as calculated at the time of designing the system. The specific additional investment cost of the solar heating system is SEK 5:40 per kWh of solar energy produced, in terms of price levels as of December 1985. The total specific cost of solar energy, including capital and maintenance costs, is calculated at 46 oere/kWh. The measurements made of the clay indicate that its geotechnical properties have been changed. Future settlement in the body of the clay is feared, although the survival of nearby buildings is not threatened. Thermodynamic characteristics of the clay have been altered only slightly. The observation period has revealed a number of effects that may be worth considering in connection with future use of clay as heat store.

36047 **Alkali metal/halide thermal energy storage systems performance evaluation.** Phillips, W.M.; Stearns, J.W. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA (US)). *Journal of Solar Energy Engineering;* 109: No. 3, 235-237(Aug 1987).

Materials compatibility and durability of advanced salt/alkali metal slurry thermal energy storage systems has been demonstrated. Applications are being evaluated for both space and terrestrial solar thermal power conversion. High energy density of these thermal storage systems is achieved by colocation of heat input and extraction within the slurry mixture which is overwhelmingly phase-change salt. This paper addresses performance testing of these systems. Understanding of mechanisms of both micro and macro stratification of the slurry is necessary to fully predict system performance as a function of gravity and system geometry. If it can be shown the gravity stratification effects are secondary to a combination of: (1) liquid metal film adhesion (wetting) to the heat exchange surfaces and solidified salt particles, (2) solubility of alkali metal in the salt-rich phase, and (3) stirring produced by liquid to vapor conversion of the alkali metal, then system geometry limitations are greatly relaxed for space application. Performance testing was accomplished using a sodium heat pipe to transfer heat from the slurry canister to a gas gap calorimeter. Testing was accomplished with the heat pipe installed only in the vapor space above the alkali metal/salt slurry and with an increase heat pipe and minimum vapor space. This testing conclusively demonstrated the effectiveness of the pseudo-heat-pipe type heat transfer mechanism operating in the slurry system under terrestrial conditions.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 35644

36048 **(DOE/GET—88/1) Geothermal Energy: Current abstracts.** Ringe, A.C. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jan-Feb 1988. 29p. (PB—88-914701). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008252/JAW.

This bulletin announces the current worldwide information available on the technologies required for economic recovery of geothermal energy and its use as direct heat or for electric power production. (ACR)

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 36059, 36060, 36069

36049 **(HNEI—8009311) Geothermal spas in Hawaii: A new tourist industry?: A preliminary report.** Woodruff, J.L. (Hawaii Univ. at Manoa, Honolulu (USA). Hawaii Natural Energy Inst.). Jul 1987. 65p. Hawaii Natural Energy Institute, University of Hawaii at Manoa, 2540 Dole Street, Honolulu, HI 96822. Order Number TI88009311/JAW.

There are at least three very good uses for active volcanism: Obtain energy from it. Study it. Enjoy it. We are already obtaining electrical energy and industrial heat from Kilauea's abundant resource by drilling geothermal wells and building power plants. Our Volcano Observatory is recognized as a world renowned center of learning about volcanism. Our Volcanoes National Park allows us to view and appreciate this awesome phenomenon. For several years people have speculated about the high potential in Hawaii for another way of enjoying this warmth of mother earth – spas or resorts that would make use of water that is naturally heated and mineralized by volcanic activity. However, before spas are developed in Hawaii, answers are needed to several important questions dealing with such topics as the suitability of our geothermal waters, sources of water that could be tapped, special equipment and materials needed, land availability, governmental and environmental hurdles, and the economics of this unique business. Though a considerable amount of research is still needed, it was felt worthwhile to summarize the information gathered to date from historical works, brochures, personal communications, and other sources. This report should stimulate interest in, and perhaps accelerate, the development of one of Hawaii's most important natural resources.

36050 **Status of the magma energy project.** Dunn, J.C. (Sandia National Labs., Geothermal Research Div., P.O. Box 5800, Albuquerque, NM (US)). pp 3-10 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

The current magma energy project is assessing the engineering feasibility of extracting thermal energy directly from crustal magma bodies. The estimated size of the U. S. resource (50,000 to 500,000 quads) suggests a considerable potential impact on future power generation. In a previous seven-year study, the authors concluded that there are no insurmountable barriers that would invalidate the magma energy concept. Several concepts for drilling, energy extraction, and materials survivability were successfully demonstrated in Kilauea Iki lava lake, Hawaii. The present program is addressing the engineering design problems associated with accessing magma bodies and extracting thermal energy for power generation. The normal stages for development of a geothermal resource are being investigated: exploration, drilling and completions, production, and surface power plant design. Current status of the engineering program and future plans are described.

36051 **Geothermal resource assessment in Honduras: How we got to Platanares.** Laughlin, A.W.; Frank, J.; Flores, W. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM (US)). pp 65-70 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

The initial phase of a geothermal resource assessment of Honduras is essentially complete. Reconnaissance scale geological and geochemical investigations were performed at six previously identified sites to determine relative potentials for electricity generation or direct heat use. Two of the six sites were eliminated because of low potential for the production of electricity and detailed geological and geochemical work was concentrated at the remaining four sites. After an evaluation of new data, two sites (Platanares and San Ignacio) were selected for detailed geophysical surveys and one (Platanares) for gradient drilling. Very encouraging results were obtained from the drilling and it is apparent that a feasibility phase investigation is warranted at Platanares.

36052 **Electricity production in Central America - Geothermal versus other options.** Trocki, L.K.; Hanold, R.J. (Los Alamos National Lab., Los Alamos, NM (US)). pp 71-78 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

Electricity demand growth slowed during the economic recession experienced in the early 1980s in Central America but elec-

tricity continues to experience the highest rate of growth in demand among all energy forms. Rapid growth is expected to resume or continue as the region's economies recover from the recession and as the rate of household electrification increases. Large hydroelectric projects have recently been completed in most of the countries. Although overcapacity exists in some countries, most of the national utilities expect to require new capacity within the next five years or earlier. All countries of the region are developing or exploring their geothermal resources. The cost of electricity generated from geothermal energy compares favorably with the cost of the alternatives in Central America. Geothermal energy also has other advantages over the alternatives, which may increase the role played by geothermal energy development by the year 2000. By 2000, at least 10 percent of Central America's electric generating capacity is expected to be geothermal.

1502 Geology And Hydrology Of Geothermal Systems

36053 (LBL—24092) Unstable heat pipes. McGuinness, M.J.; Pruess, K. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 6p. (CONF-871111—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010780/JAW.

From 9. New Zealand geothermal workshop; Auckland, New Zealand (4 Nov 1987).

Heat pipes are an important feature of models of vapor-dominated geothermal reservoirs. Numerical experiments reveal that a vapor-dominated heat pipe is unstable if pressure is controlled at shallow levels. This instability is discussed in physical terms, and some implications for geothermal reservoirs are considered. 9 refs., 10 figs.

36054 (LBL—24463) A semi-analytical method for heat sweep calculations in fractured reservoirs. Pruess, K.; Wu, Y.S. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 6p. (CONF-880111—5). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008245/JAW.

From 13. workshop on geothermal reservoir engineering; Stanford, CA, USA (19 Jan 1988).

An analytical approximation is developed for purely conductive heat transfer from impermeable blocks of rock to fluids sweeping past the rocks in fractures. The method was incorporated into a multi-phase fluid and heat flow simulator. Comparison with exact analytical solutions and with simulations using a multiple interacting continua approach shows very good accuracy, with no increase in computing time compared to porous medium simulations. 14 refs., 3 figs., 5 tabs.

36055 (LBL—24973) Some effects of non-condensible gas in geothermal reservoirs with steam-water counterflow. McKibbin, R.; Pruess, K. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 8p. (CONF-880111—6). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008246/JAW.

From 13. workshop on geothermal reservoir engineering; Stanford, CA, USA (19 Jan 1988).

A mathematical model is developed for fluid and heat flow in two-phase geothermal reservoirs containing non-condensible gas (CO_2). Vertical profiles of temperature, pressures and phase saturations in steady-state conditions are obtained by numerically integrating the coupled ordinary differential equations describing conservation of water, CO_2, and energy. Solutions including binary diffusion effects in the gas phase are generated for cases with net mass throughflow as well as for balanced liquid-vapor counterflow. Calculated examples illustrate some fundamental characteristics of two-phase heat transmission systems with non-condensible gas. 14 refs., 3 figs.

36056 In-situ stress orientation and magnitude at the Fenton geothermal site, New Mexico, determined from wellbore breakouts. Barton, C.A.; Zoback, M.D.; Burns, K.L. (Department of Geophysics, Stanford University, California). *Geophysical Research Letters;* **15**: No. 5, 467-470(May 1988).

The acoustic borehole televiewer provides excellent data for the detection and measurement of stress-induced wellbore breakouts. Analog televiewer data from the Fenton Geothermal well EE-3 in New Mexico were digitized and interactively processed for detection and analysis of azimuth and shape of stress-induced breakouts occurring in the well at depths of about 2.9—3.5 km. A statistical analysis of the measured breakout azimuths yields a well resolved orientation of least horizontal principal stress of 119°, consistent with least principal stress data from the Rio Grande Rift. As the magnitude of the least horizontal compressive stress, S/sub hmin/, in EE-3 is known from hydraulic fracturing, we present a new method in which S/sub hmin/ and data on breakout width are used to estimate the magnitude of the maximum horizontal principal stress. copyright American Geophysical Union 1988

36057 Exploration geothermal gradient drilling, Platanares, Honduras, Central America. Goff, S.; Laughlin, A.W.; Rufenacht, H.D.; Goff, F.; Heiken, G.; Ramos, N. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM (US)). pp 55-64 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

This paper is a review and summary of the core drilling operations component of the Honduras Geothermal Resource Development Project at the Platanares geothermal prospect in Honduras, Central America. Three intermediate depth (428-679 m) coreholes are the first continuously cores geothermal exploration boreholes in Honduras. These coring operations are part of the Cental America Energy Resource Project (CAERP) effort funded by the Agency for International Development (AID) and implemented by the Los Alamos National Laboratory (Los Alamos) in cooperation with the Empresa Nacional de Energia Electrica (ENEE) and the United States Geological Survey (USGS). This report emphasizes coring operations with reference to the stratigraphy, thermal gradient, and flow test data of the boreholes. The primary objectives of this coring effort were (1) to obtain quantitative information on the temperature distribution as a function of depth, (2) to recover fluids associated with the geothermal reservoir, (3) to recover 75% or better core from the subsurface rock units, and (4) to drill into the subsurface rock as deeply as possible in order to get information on potential reservoir rocks, fracture density, permeabilities, and alteration histories of the rock units beneath the site. The three exploration coreholes drilled to depths of 650, 428 and 679 m, respectively, encountered several hot water entries. Coring operations and associated testing began in mid-October 1986 and were completed at the end of June 1987.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 36051, 38169

36058 (CRIE-U—87006) Geothermal exploration by geochemical and geophysical methods. Study on the geothermal structure model restricting Shikano hot spring. Kiho, Kenzo; Kusunoki, Ken'ichiro; Suzuki, Koichi; Inoue, Daiei; Miyakawa, Kimio; Kitano, Koichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 51p. (In Japanese). NTIS (US Sales Only), PC A04. Order Number DE88770185/JAW.

Evaluation of geothermal resources is important for the geothermal development. Geochemical and geophysical exploration were carried out at Shikano hot spring area, Tottori, Japan, on purpose to verify the efficiency of these exploration methods and a flow model of the spring was proposed. Methods of survey are geological study, soil gas exploration, study on isomers of oxygen and hydrogen, study on 1m depth temperature, MT exploration method which were conducted during April and July of 1986. Hot spring distribution is approximately 1 km in the direction of NNE-SSW, and is of simple salty type with temperature 50 - 85 °C. Mercury can be an index of under-ground temperature as its vapor pressure goes up extraordinarily as the temperature goes up. Zones of low specific resistance reflect the existing condition of under-ground

water. 1 m depth temperature indicates the distribution of narrow range under-ground geo-water. Geo-waters pass through this zone and along the boundary of the Yoshioka and the Tottori granites and extend along the section of NNE-SSE. (33 figs, 6 tabs, 16 refs)

36059 **(ETSU-G—131-P1) Investigations of the UK heat flow field (1984-1987). Investigation of the geothermal potential of the UK.** Gebski, J.S.; Wheildon, J.; Thomas-Betts, J. (British Geological Survey, Keyworth. Geothermal Resources Programme; UKAEA Harwell Lab. Energy Technology Div.). 1987. 84p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ. Order Number TI88102095/JAW.

Between 1984 and 1987, twenty-two new heat flow measurements have been added to the previously reported coverage of around 200 observations. These include observations in two deep boreholes drilled as part of the BGS geothermal exploration programme. Eleven of the sites were specially drilled heat flow boreholes between 100 m and 300 m deep. The remaining observations were made at locations where additional refinement of the heat flow field was warranted. Much of the effort in the present programme has been towards a better definition of the heat flow field associated with the high heat producing granites of the Lake District and Weardale, particularly where the granite extends in the subsurface to the edge of the Tyneside urban conurbation. The apparent high heat flow in the Bowland Forest can no longer be sustained, and the previously reported high heat flows are judged to be enhanced through convective circulation. Some refinements of the heat flow field in the Midland Valley of Scotland and in South Wales have resulted from new observations in these areas.

36060 **(ETSU-G—133-P1) Diagenetic influences on the aquifer properties of the Sherwood Sandstone in the Wessex Basin. Investigation of the geothermal potential of the UK.** Milodowski, A.E.; Strong, G.E.; Wilson, K.S.; Allen, D.J.; Holloway, S.; Bath, A.H. (British Geological Survey, Keyworth. Geothermal Resources Programme; UKAEA Harwell Lab. Energy Technology Div.). 1986. 96p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ. Order Number TI88102094/JAW.

In the Wessex Basin, the Sherwood Sandstone Group is a potential reservoir for geothermal energy. The sandstone is characterized by thin coarse-grained layers with permeabilities of up to 5 or 6 darcys and porosities of about 25 per cent. The occurrence of these zones is a consequence of the initial grain-size of the sandstone and its diagenetic history. Early cementation of significant parts of the sandstone sequence, by carbonates and anhydrite, preserved the rock fabric when it was buried subsequently to greater depths by younger sediments. Of the two cements, the anhydrite was the most significant from the point of view of reservoir properties, for its subsequent dissolution regenerated the original primary porosity and permeability. This was enhanced by the solution of potassium feldspars. The most favourable areas for developing geothermal resources, are south of the Mere Fault and, in particular, in the Dorset Basin between the Cranborne Fault and the Purbeck-Isle of Wight faults.

36061 (NAGRA-NTB—87-15, pp 521-534) **Geothermal conditions in Northern Switzerland.** Rybach, L.; Eugster, W.; Griesser, J.C. (Eidgenoessische Technische Hochschule, Zurich (Switzerland); Basler und Hofmann AG, Zurich (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

The geothermal field in northern Switzerland, derived from a great number of borehole temperature measurements, is characterized by a strongly positive temperature gradient and heat flow anomaly (>150 mWm^2) in the lower Aare valley. The anomaly is centered above the recently discovered Permocarboniferous trough. Several possibilities to explain the anomaly (thermal disturbance in the mantle, cooling shallow intrusion, locally strong uplifterosion, local contrasts in petrophysical properties) can be ruled out on the basis of model calculations. Uprising deep groundwater is favoured as the mechanism creating the observed anomaly. Deep groundwater circulation was investigated in detail, especially to clarify the hydraulic role of the Permocarboniferous trough, by coupled thermo-hydraulic modelling, using the integrated finite difference technique. The model was carefully validated by field data. The results reveal the draining effect of the Permocarboniferous trough and indicate that vertical permeability is present in the vicinity of the trough even at depths of several kilometers. They further imply that large parts of the crystalline basement in northern Switzerland have average hydraulic conductivities $>10^{-9}$ msec and that Darcy velocities in the order of 10 mmyear must be expected. (author) 24 refs., 4 figs., 1 tab.

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 36052

1506 Environmental Aspects And Waste Disposal

36062 **(ETSU-G—133-P2) Geothermal development - an assessment of the risk of surface subsidence. Investigation of the geothermal potential of the UK.** Williams, A.T. (British Geological Survey, Keyworth. Geothermal Resources Programme; UKAEA Harwell Lab. Energy Technology Div.). 1986. 24p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ. Order Number TI88102093/JAW.

The reduction of pressure in a confined aquifier can cause compaction of the aquifer and the confining layers leading to surface subsidence. It is possible that the development of hot brines in deep aquifers in the UK could cause surface subsidence. The possible causes of subsidence are the compaction of the aquifer material and particularly of the confining layers because of both pressure and temperature changes. It is necessary at the present time to make assumptions about rock properties and operating conditions in a geothermal well before an estimate can be made of the probable magnitude of surface subsidence. Accepting the factors that are most likely to be encountered under operational conditions leads to an estimate of 0.1 m for compaction. It is concluded that more work is necessary to study the problem in detail before any long-term development of geothermal energy could be considered.

1508 Geothermal Power Plants

36063 **(BNL—41162) Decreasing geothermal energy conversion costs with advanced materials.** Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 13p. (CONF-880477—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012135/JAW.

From DOE geothermal program review; San Francisco, CA, USA (19 Apr 1988).

If the Geothermal Technology Division (GTD) is to meet its programmatic objectives in hydrothermal fluid production and energy conversion, it is essential that new materials of construction be available. Level III Program Objectives include (1) reducing the costs associated with lost circulation episodes by 30% by 1992, (2) reducing the costs of deep wells and directionally dried wells by 10% by 1992, (3) reducing well-cementing problems for typical hydrothermal wells by 20% by 1991, and (4) the development of a corrosion-resistant and low-fouling heat exchanger tube material costing no more than three times the cost of carbon steel tubes by 1991. The Brookhaven National Laboratory (BNL) materials program is focused on meeting these objectives. Currently, work is in progress on (1) high temperature chemical systems for lost circulation control, (2) advanced high temperature (300°C), lightweight (~ 1.1 g/cc), CO_2-resistant well cementing materials, (3) thermally conductive composites for heat exchanger tubing, and (4) ultra high temperature (600°C) cements for magma wells. In addition, high temperature elastomer technology developed earlier in the program is being transferred for use in the Geothermal Drilling Organization programs on drill pipe protectors, rotating head seals, and blow-out preventors. Recent accomplishments and the current status of work in each subtask are summarized in the paper.

36064 **Performance improvements in binary geothermal power plants using advanced concepts.** Bliem, C.J.; Mines, G.L. (Idaho National Engineering Lab., Idaho Falls, ID (US)). pp 329-334 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

The proper choices of a working fluid, component designs, and operating conditions provide improvements in performance in binary geothermal power plants. This study considers pure and mixed hydrocarbon working fluids for binary plants utilizing moderate temperature (450-475 K) hydrothermal resources. The use of halocarbon mixtures is also discussed. For working fluid mixtures, the performance improvement obtained by using a condenser in which the working fluid is condensed in countercurrent flow and with the liquid and vapor phases remaining mixed (integral condensation) is considered. The effect of modification of turbine inlet state points to achieve supersaturated vapor turbine expansions is presented, and the use of a turbine-exhaust recuperator to preheat geofluid using thermal energy from the turbine exhaust is discussed. The Heber plant, a 45 MEWe binary plant built by San Diego Gas & Electric Company in cooperation with EPRI, the US DOE and other utilities, is taken as the baseline binary plant for these investigations. The improvements studied here have not been used in the Heber or other existing binary plants. With these advanced concepts, the performance of a binary geothermal power plant operating with a resource between 450 and 475 K may be improved 25 to 30% over the present state-of-the-art plant as represented by the Heber plant.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 36050

36065 **(CRIE-U—86043) Development of rock fracture evaluation technique for hot-dry-rock system. Expansion of fracture estimated from AE measurements made during large-scale hydraulic fracturing test.** Umieda, Hideshi; Sasaki, Shunji. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 36p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752542/JAW.

For heat extraction from a hot dry rock, it is necessary to create an artificial fracture zone in a hot dry rock to provide a geothermal water reservoir. The most promising means for this may be hydraulic fracturing through boreholes provided in the hot dry rock. Recently, large-scale hydraulic fracturing tests at a depth of 3,500 m were carried out by Los Alamos National Laboratory. The rock temperature was about 250°C. In the present study, the acoustic emission (AE) generated from rock fracturing during the tests are analyzed to determine the mechanism of the expansion of fractures within the rock produced by hydraulic fracturing. Results show that most fractures result from shear failure in the rock and that the created fracture zone expands three dimensionally rather than in the form of a single plane. The direction of slip at each fault plan depends on the hydraulic fracturing point. It is suggested that this may be attributed to discontinuity of the rock due to geological variations or existing cracks, rather than to local variations in the direction of stresses within the rock. (18 figs, 5 tabs, 1 photo, 14 refs)

36066 **(LBL—25245) Reducing long-term reservoir performance uncertainty.** Lippmann, M.J. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 6p. (CONF-880477—4; CONF-880477—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010781/JAW.

From DOE geothermal program review; San Francisco, CA, USA (19 Apr 1988).

Reservoir performance is one of the key issues that have to be addressed before going ahead with the development of a geothermal field. In order to select the type and size of the power plant and design other surface installations, it is necessary to know the characteristics of the production wells and of the produced fluids, and to predict the changes over a 10–30 year period. This is not a straightforward task, as in most cases the calculations have to be made on the basis of data collected before significant fluid volumes have been extracted from the reservoir. The paper describes the methodology used in predicting the long-term performance of hydrothermal systems, as well as DOE/GTD-sponsored research aimed at reducing the uncertainties associated with these predictions. 27 refs., 1 fig.

36067 **Development and field performance of a high temperature geothermal turbodrill.** Neudecker, J.W.; Rowley, J.C. (Los Alamos National Lab., Los Alamos, NM (US)). pp 227-232 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

The successful completion of a pair of geothermal energy extraction wells in hot granite to depths of over 15,000 feet as part of the Hot Dry Rock Geothermal project at Fenton Hill, New Mexico required the development of special turbodrill downhole motors and high precision directional drilling techniques to drill the highly deviated holes. The turbodrills contained no elastomer seals or bearings and were designed to operate at bottom hole temperatures in excess of 600° with high torque capability in order to drill the granite with tungsten carbide insert (TCI) roller cone bits. The fluid flow and torque characteristics were investigated by laboratory drilling tests in hard granite blocks. Subsequent field directional drilling experience proved the capability of the turbodrills to drill in hot granite at rates of up to 50 ft. per hour. The turbodrills were used in conjunction with bent subs and steering tools to directionally drill both 12-1/4 and 8-3/4 in. diameter holes. The deepest well was drilled to a measured depth of 15,300 ft. with nearly 8500 ft. directionally drilled to a final inclination of 35° from the vertical and to a tightly controlled azimuthal orientation.

36068 **High temperature drilling fluid field experience and analysis.** Aguilar, R.G. (Los Alamos National Lab., Los Alamos, NM (US)). pp 173-178 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

The Hot Dry Rock Project has experienced numerous downhole problems while drilling with water and torque reducing agents through hot crystalline granitic rock. Among these problems are high corrosion rates and abrasion, hardware fatigue failures, loss of directional control, numerous fishing jobs, poor mineralogical evaluation and low drilling rates. During recent drilling operations, a modified high temperature drilling fluid was used. The lubricity and corrosion aspects of the fluid were extensively monitored during its use. The performance of the drilling fluid was exceptional. It allowed rapid drilling from 2800 m to 4025 m at an average drill rate of 3.6 m/hr with no downhole failures, good cuttings removal, and easily controlled drag and torque. The only significant drawback was that upon continuous cyclic exposure to elevated temperatures the main component, sepiolite, under-went a phase change to a smectite, causing increased hole drag and torque.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 36051

36069 **The direct application of geothermal energy to provide process heat in Guatemala.** Altseimer, J.H.; Edeskuty, F.J. (Los Alamos National Lab., Los Alamos, NM (US)). pp 49-54 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

One part of an energy and resource development program in Central America is a geothermal process heat project in Guatemala. The feasibility of the direct heat application depends upon the production characteristics and reliability of the geothermal source. Other factors are the distance from the heat source, quantity of use, and capacity factor of the use facilities. Favorable conditions would be distances of under 5 km, heat requirements approximately equal

to the well capacity, and high capacity factors (say 60% or higher) in the industrial plants. Depending upon the values of these factors, energy costs of less than $1.00/million Btus to greater than $5.00/million Btus have been estimated. This can be compared to about $5.00/million Btus for petroleum-based fuels in Guatemala in mid 1987. A survey was made of existing industries in the Amatitlan and Zunil geothermal areas. In both Amatitlan and Zunil the existing industries are spread out over an area too large to be called an optimum. The most promising situation for an industrial park development is at Amatitlan, except that proven production wells are not yet available. At Zunil, production wells exist, but a diverse nearby industrial base does not. However, both of these two areas are sufficiently promising to merit further development. Consequently, a demonstration project is underway aimed at the ultimate establishment of an agricultural processing center at Zunil. This center would have the capability to process agricultural products by dehydration, freezing, and cold storage.

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

36070 **(BFTPRB—111977) Reassessment of Fundy tidal power: reports of the Bay of Fundy Tidal Power Review Board.** (Bay of Fundy Tidal Power Review Board, Nova Scotia (Canada)). Nov 1977. 573p. (CE—01482). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents a feasibility study on cost effective tidal power generation in the Bay of Fundy. The characteristics of various sites in the Bay are examined and possible plant configurations and operating schemes are detailed. Construction and design concepts are discussed and the component parts including generating equipment, are analyzed. Of the tidal power sites which would be capable of producing significant amounts of energy, those at the mouth of Cumberland Basin, Cobequid Bay and Shepody Bay would provide the best prospects for development. The construction of a tidal power plant at any of these sites would be technically feasibile. Under the economic conditions expected to prevail up to and beyond 2000 single basin schemes operated for maximum energy output would offer the lowest unit costs of energy, and would eliminate some fossil-fuelled generation from the Maritime utilities expansion programs. Economic assessment has conclusively demonstrated the fundamental economic feasibility of tidal power and the technical and economic feasibility of its integration into the project generation supply systems of the Maritime Provinces. Because of the large minimum investment, financial feasibility of a tidal power plant would be conditional upon substantial direct participation by governments. The Cumberland Basin site was found to be the preferred candidate project for initial development for many reasons including those deriving from the fact that the project is the smallest of the three projects considered potentially viable. 153 figs., 87 tabs.

36071 **(BFTPRB—111977) Reassessment of Fundy tidal power.** (Bay of Fundy Tidal Power Review Board, Nova Scotia (Canada)). Nov 1977. 57p. (CE—01481). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report is a summary of a larger report on the feasibility of a tidal power plant in the Bay of Fundy using single-basin schemes with low-head turbines. Three sites out of the many possibilities were selected for intensive study, and their design, construction, and operating conditions are outlined. Since the major objective of the main report was to investigate cost effectiveness of such a project, various aspects of this objective are examined, including power demand expected in the Maritime Provinces, Quebec, and New England, capital costs, comparison with alternative generating schemes, effects of interest rates, inflation and other socioeconomic factors, and environmental concerns. Overall indications point to technical and economic feasibility, with Cumberland Basin being the preferred site. 30 figs., 12 tabs.

1608 Wave Energy Converters

36072 **(CEGB-RM/M/N—1144) Experimental investigation of point absorber arrays.** Count, B.M.; Knott, G. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.; UKAEA Harwell Lab. Energy Technology Div.). Nov 1980. 16p. (ETSU-WV—1557-Pt.1). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Wave energy devices, in a three dimensional description, can have substantial interaction effects which can dramatically improve their absorption characteristics. To validate these predictions a series of experiments were undertaken with arrays of axially symmetric devices, more usually known as point absorbers. A series of vertically oscillating point absorbers were tested with the facilities, to vary device tuning and array geometry conveniently. A theory of 'point absorber' arrays is presented demonstrating that the performance in certain array configurations can be two to three times that achieved by an isolated device. These results refer to an optimised system and are sensitive to device spacing and incident wave direction. Non optimum performance is analysed using numerical hydrodynamic models developed at MEL and these results are compared with a set of experiments carried out for technical Advisory Group 1 of the Wave Energy Steering Committee, at the wide tank at Edinburgh University. The results confirm the theoretical predictions.

36073 **(ETSU-WV—1500-Pt.1) HRS rectifier. Model tests in random waves.** (UKAEA Harwell Lab. Energy Technology Div.; Hydraulics Research Station, Wallingford (UK)). Dec 1979. 36p. (HR-EX—903). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The performance of the model, although a most inefficient design, supported the theoretical predictions of behaviour in monofrequency and random waves. Theory predicts, for a suitably proportioned rectifier, a high performance over a very wide frequency range. From force measurements the most probable maximum forces acting in the lifetime of the structure have been derived. Although sited in a kelp forest the ingress of material would not appear to present a serious problem.

36074 **(ETSU-WV—1500-Pt.2) HRS rectifier. Model tests in mono-frequency waves.** (Hydraulics Research Station, Wallingford (UK); UKAEA Harwell Lab. Energy Technology Div.). Nov 1978. 44p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Monofrequency wave tests were carried out on four model configurations to examine the response of the rectifier to the various wave parameters and hence find the dimensions for optimum performance. Efficiencies, higher than anticipated, were obtained, the maximum being about 70%, and the range of benefits to be gained by working in relatively shallow water were confirmed. Although the complete optimisation will depend upon the design and construction method employed as well as upon a more precise knowledge of the inshore wave climate, the rectifier is now seen as a structure 30 m wide, 20-25 m high, sitting on the sea-bed in 15 m of water.

36075 **(ETSU-WV—1500-Pt.3) HRS rectifier. Theory and analysis.** (UKAEA Harwell Lab. Energy Technology Div.; Hydraulics Research Station, Wallingford (UK)). Mar 1980. 19p. (HR-EX—921). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The theory presented, shows the Rectifier to have high potential; the maximum efficiency in sine waves is predicted to be 96%. A broad band response resulting from multiple internal reflections of the fundamental and its harmonics gives an efficiency of 80% or greater over a period range of 6s to 14s when sited in 15m of water. Applying the theory to random waves gives a peak efficiency of 81% and an efficiency of 70% or greater over the same period range. The important design factor to emerge was the significance of the harmonics, generated by the intermittent action of

the gates. In order to optimise the performance, the internal geometry of the Rectifier should be kept as simple as possible to allow full development of the various resonances. The effect of inertia in the turbo-generator system is assessed.

36076 **(ETSU-WV—1508-Pt.2) Computer program to calculate the response motion of Cockerell raft wave energy devices.** (UKAEA Harwell Lab. Energy Technology Div.; National Maritime Inst., Feltham (UK)). Aug 1980. 114p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A computer program has been written which calculates the response motions, hinge reaction forces and mean rate of energy extraction of the Cockerell Rafts Wave Energy Device. This report contains a description of the program, a guide for users and some validation of the program.

36077 **(ETSU-WV—1510-Pt.1) Preliminary assessment of the environmental effects of wave energy systems deployed off the Outer Hebrides.** (UKAEA Harwell Lab. Energy Technology Div.; Hydraulics Research Station, Wallingford (UK)). Nov 1977. 43p. (HR-EX—796). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The study had two phases. During the first, HRS assessed the effects of converters situated between 10 and 50 km offshore on the waves, tides and beaches of the chosen study area, which is to the west of the islands of South Uist, Benbecula, and North Uist in the Outer Hebrides. The likely alterations to tides were found to be small, as were the changes for both short period and long period waves. For waves of medium period, however, the wave conditions at the shoreline will be reduced significantly, even for converters located 50 km offshore. Because of less wave activity and less steep waves, there will be a tendency for sandy beaches to accrete. In the second phase of the study, HRS contacted a considerable number of organisations with specialist knowledge in the environmental sciences, navigation etc, and asked their opinions about the effects of the converters in their particular fields of interest.

36078 **(ETSU-WV—1512-Pt.6) Wave power project. Preliminary report on the use of tunnels for power transmission.** (UKAEA Harwell Lab. Energy Technology Div.). Oct 1979. 8p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A brief report is given on a preliminary investigation on the use of tunnels for transmitting power generated offshore by wave energy conversion devices. The tunnels would carry the power cables with a total capacity of 2 GW. After discussing the geology of the area to the west of Uist, some estimates of likely costs and timescale are given.

36079 **(ETSU-WV—1512-Pt.8) Wave enery report on the electrical aspects of the Edinburgh University wave energy device.** (UKAEA Harwell Lab. Energy Technology Div.). Nov 1979. 82p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

An assessment is given of the electrical aspects associated with the wave energy device known as the Edinburgh Duck. Topics covered included synchronous generators and their control equipment, spine cable arrangements, sea to shore transmission and cost estimates. The use of gyroscopes as rotating energy stores is also mentioned.

36080 **(ETSU-WV—1517-Pt.2) United Kingdom wave energy programme. Consultants second report. Vol. 2. Technical appraisal of the devices.** (UKAEA Harwell Lab. Energy Technology Div.; Rendel Palmer and Tritton, London (UK); Society of Local Authority Chief Executives (SOLACE), Northampton (UK)). Aug 1978. 262p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

An assessment is given of the various wave energy devices under development in 1978 in the UK. These include the oscillating water column, Cockerell rafts, Salter ducks and the Flexible Bag. Other topics discussed include the generation and transmission of electricity, the reliability, the annual productivity and the moorings.

36081 **(ETSU-WV—1528-Pt.2) Power conversion systems for ducks.** Salter, S.H. (UKAEA Harwell Lab. Energy Technology Div.). 1987. 22p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

This paper tries to define the problems of power conversion for a wave power device. It presents a little of the background theory; it discusses design principles, existing components and modifications to them; it tries to identify the main practical difficulties. Finally, it describes four possible solutions.

36082 **(ETSU-WV—1538-Pt.1) Development of the L.F.B. wave energy converter 1975-1982.** French, M.J.; Chaplin, R.V. (UKAEA Harwell Lab. Energy Technology Div.). Sep 1982. 90p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

This report describes work done in the Department of Engineering at Lancaster Flexible Bag (LFB) wave energy converter. Most of the work was funded by the Department of Energy but the early stages were supported by the Science Research Council. Chapter 2 gives notes on the various development stages and chapter 3 outlines our current theoretical understanding of attenuators. This theoretical understanding has come relatively recently and the considerably higher powers predicted for devices with phase lead resulting from particular bag stiffnesses are currently being tested in a 1/60 scale rig. In chapter 4, three forms of the device are considered, with decreasing detail: 'the tension leg' version, 'the stiff floater' and the 'series parallel'. The prospects for all of them depend on the theoretical predictions of the benefits of phase lead proving justified in experiments. Given that these benefits were real, the device could be economic.

36083 **(ETSU-WV—1549-Pt.1) Performance tests on a two-stage Wells turbine.** Grant, R.J.; Johnson, C.G. (UKAEA Harwell Lab. Energy Technology Div.). Oct 1980. 13p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A Wells turbine consisting of a two-stage rotor with inlet/outlet and intermediate guide vanes has been tested in steady flow. The model and test equipment was similar to that used in an earlier series of single stage tests, and the present model was tested at rotational speeds up to 6000 r.p.m. and at flow rates well into the stalled region at lower speeds. The unstalled performance of the model was very similar to what would be obtained by doubling the single stage performance parameters as appropriate, and this suggests that no detrimental interference effects were taking place between the stages. In addition, the decrease in power output as the machine stalled was less abrupt than with the single stage model. Traversing is in hand to investigate this effect and a preliminary result is presented.

36084 **(ETSU-WV—1551-Pt.2) Parametric study of single hinged raft systems.** Count, B.M. (UKAEA Harwell Lab. Energy Technology Div.; Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). May 1979. 19p. (CEGB-R/M/N—1062). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The work described which has been undertaken under contract for Wave Power Limited, considers the characteristics of a class of wave power devices that consist of two hinged floats. Theoretical methods developed by the author have been used for the study for which the primary objective has been to calculate the power extraction capability and required loading characteristics of these devices. The two major variables considered are the relative size of the two floats and the overall shape of the device. These two parameters are considered separately and simple hinged shallow draught floats of variable relative length are analysed in detail both with and without restraints on the rear section. Hybrid devices in which the front section is deformed into a shorter, deeper structure are analysed only in the case where the rear float is stationary.

36085 **(ETSU-WV—1551-Pt.29) Lancaster Flexible Bag. Design of non-return valves for the Bag cells.** Hancock, M. (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Jan 1981. 2p. (WP—128). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The LFB non-return valve comprises 4 frames each of which have 4 hinged flaps giving a $4m^2$ inlet area and $6m^2$ total frame area (shown on WPL drawings W14-11 and W14-12). This arrangement should give excellent sealing which has been identified as a crucial design point. The optimisation of the valve performance and the basis for material selection are outlined. Cast aluminium appears to be the most economical material for flap and frame although work is in progress to confirm this choice.

36086 **(ETSU-WV—1551-Pt.30) Lancaster Flexible Bag. Second report on the design of non-return valves for the Bag cells.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Oct 1981. vp. (WP—135). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A progress report is given on the design of and the scale model tests of non-return valves for the individual bag cells in the wave energy conversion device known as the Lancaster Flexible Bag. It was concluded that the flaps will close in reverse flows even without closing assistance.

36087 **(ETSU-WV—1551-Pt.34) Lancaster Flexible Bag wave energy device. Auxiliary systems.** Michael, W.R. (UKAEA Harwell Lab. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). Aug 1981. vp. (YR—2691/81). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The report presented outlines designs for auxiliary systems required to support power generation on the Lancaster Flexible Bag wave energy device. The work includes an estimate of the cost of supplying and installing these systems. The necessary future work to complete the final design and aspects of the systems requiring detailed attention are described.

36088 **(ETSU-WV—1551-Pt.37) Study of the operation and maintenance costs of the Wavepower Limited Lancaster Flexible Bag system.** Corrie, N.J.B. (UKAEA Harwell Lab. Energy Technology Div.; Easams Ltd., Camberley (UK)). Nov 1981. 80p. (EASAMS—2698). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A maintenance strategy to support the credibility of the Lancaster Flexible Bag wave energy concept, covering scheduled maintenance (servicing and overhaul) and unscheduled maintenance (repair) has been developed and costed. Costs are presented on an annual basis for a turbo-alternator overhaul life of five years (for helicopter and hovercraft maintenance crew transit options) and for a turbo-alternator overhaul life of ten years (hovercraft transit option only). For the case where a turbo-alternator overhaul life of ten years is specified, annual scheduled maintenance costs, including replacements, are Pound 16.15M (0.092 p/kW-h installed); repair and contingency costs are Pound 8.64M (0.050 p/kW-h installed).

36089 **(ETSU-WV—1551-Pt.38) Definition and design of condition monitoring system for the Lancaster Flexible Bag wave energy system.** Megson, N.C. (UKAEA Harwell Lab. Energy Technology Div.; Easams Ltd., Camberley (UK)). Nov 1981. 29p. (EASAMS—2733). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This study covers the definition and design of a condition monitoring and control system necessary to protect the viability and operation of an array of 250 Lancaster Flexible Bags (LFBs) off the west coast of the Outer Hebrides. The proposed array of LFBs is to collect and transmit a maximum of 2 GW of electrical power to supply the grid system on the Scottish mainland.

36090 **(ETSU-WV—1551-Pt.41) Wave induced bending moments. A prediction method using an advanced mixed sea basin.** Hancock, M. (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Jan 1982. 37p. (WP—141). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The Cadnam Mixed Sea Basin generates stable and repeatable mixed seas enabling wave induced bending moments on a floating structure to be accurately determined for a range of sea states. This data is combined with a record of sea state occurrence at the intended location in a probabilistic analysis which yields the distribution of bending moments over any desired period of operation.

36091 **(ETSU-WV—1551-Pt.48) Computer simulation of the Lancaster Flexible Bag. Description of method, program code and operation.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Sep 1982. 34p. (WP—145). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A brief report and print-out of the computer program used are given for the computer simulation of the wave energy device known as a Lancaster Flexible Bag. The development of the theory and the equations used are presented and the numerical method and solution of the equations outlined.

36092 **(ETSU-WV—1551-Pt.49) Markov model of air power.** (UKAEA Harwell Lab. Energy Technology Div.). Sep 1982. 4p. (WP—148). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Statistical models are being developed to predict power surges over a typical range of sea states for wave energy converters in which air enclosed by a flexible element is pumped through a turbine by wave pressure. The success of Markov simulations is discussed. Present Markov models can predict surges accurately where they occur in high energy cases, but not in low energy cases.

36093 **(ETSU-WV—1551-Pt.52) Experimental investigation of the loads on a 2 dimensional model of a bottom standing LFB design.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Sep 1982. 24p. (WP—150). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A brief report is given of wave tank tests of the wave energy conversion device known as the Lancaster Flexible Bag. The tests under both normal and extreme sea states are to provide structural strength information for devices mounted on the sea bed. With the two-dimensional model used, it is concluded that the main determinant of structural load is wave height.

36094 **(ETSU-WV—1551-Pt.53) Tube mooring and spring development programme.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Sep 1982. 35p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given on the development programme on tube moorings and high pressure seawater pumps for the Bristol cylinder wave energy device. Applications to the Lancaster Flexible Bag are also discussed. The theoretical calculations are compared with scale model tests with tube bores up to 100 mm diameter and these provide confirmation of the theory. Fatigue characteristics are also studied for the tube material.

36095 **(ETSU-WV—1551-Pt.55) Reliability assessment and its application to the wave energy programme.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Sep 1982. 19p. (WP—154). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Two significant factors in wave energy economics are the system availability and the costs of repairs, both of which are sensitive to the reliability of the components involved. The question to be considered here is whether a reliability assessment made at the design stage is acceptable as a tool for making judgements regard-

ing the economic viability of a wave energy system or for making comparisons between alternative systems. A particular aspect of this question is whether the approach to reliability assessment adopted for the current programme is appropriate for predicting the reliability to be expected at the conclusion of the development cycle.

36096 **(ETSU-WV—1551-Pt.57) Comparative tests between a manifolded air system and linear and quadratic damping applied to a single air cell of the Lancaster Flexible Bag.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Sep 1982. 38p. (WP—151). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Work by both Wavepower Limited and SEA has shown that an economic route to wave energy conversion may be obtained through a device with a closed power air circuit which is fed by a number of air filled flexible membranes whose motion is governed by the incident sea waves. Comparison of wide tank test results of the Clam and LFB showed that the former produced significantly more power, although a similar device in terms of overall dimensions. The most likely explanation of this difference was considered to be the difference in the air power conversion system. To investigate further into the differences between these two power take off systems, the models were reduced to a simplified two dimensional test rig, making it possible to measure both bag and power characteristics in isolation from the effects of spine dynamics.

36097 **(ETSU-WV—1551-Pt.58) Summary of model test programme conducted by Wavepower Limited on the Lancaster Flexible Bag.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Sep 1982. 6p. (WP—157). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A summary is given of wave tank tests on models of the Lancaster Flexible Bag wave energy converter. The total power output was measured for various sea states including mixed seas. The model scale was 1:75.

36098 **(ETSU-WV—1581-Pt.11) Wave energy devices - a reliability study of the power generating plant in a 360MW Bristol Cylinder device array.** James, R.E. (UKAEA Harwell Lab. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). Mar 1982. 78p. (YR—2730/81). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The failure characteristics and potential corrective maintenance strategies of the power plant for a 360MW device array are studied. The major conclusion is that, with the design in its present form, a very large number of very small effect failures could result in a persistent power loss of sizeable proportion unless responded to without undue delay. It recommends that a strategy for dealing with them plus an alternative means of rectification should be developed to permit cost effective repair of these small effect failures. It also highlights aspects within the design which might result in unsafe consequences, with respect to plant or maintenance personnel, and recommends a deeper consideration of them by the design team.

36099 **(ETSU-WV—1587-Pt.1) Implications for fisheries of siting wave energy converters in the Moray Firth.** Lampitt, R.S. (UKAEA Harwell Lab. Energy Technology Div.). 1987. 102p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given which assesses the effect of siting a string of wave energy converters (WEC's) across the mouth of the Moray Firth with particular reference to the fishing industry. The first four sections provide background information on the marine environment, the biology of the major fish species and the state of the commercial fishery. In section V the effect of WEC's on the fishery are discussed. Such an effect may be 1) by an environmental change; 2) by a direct effect on fish; 3) by loss of access to fishing grounds; or 4) by loss of free passage to fishing grounds.

36100 **(ETSU-WV—1612-Pt.1) Review of current methods for analysing the characteristics of mooring systems with particular reference to non-linear response and extreme mooring forces. Part 1. Analytical methods.** Chan, H. (UKAEA Harwell Lab. Energy Technology Div.). Mar 1980. 45p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A review is given of the current methods available to analyze the characteristics of mooring systems for all types of floating wave energy devices. Particular attention is paid to the estimation of non-linear responses and extreme mooring forces. A collection of recently developed computer programs is given.

36101 **(ETSU-WV—1614-Pt.1) Appraisal of mass production costs for wave energy devices.** (UKAEA Harwell Lab. Energy Technology Div.; P-E Consulting Services Ltd., Egham (UK)). Mar 1980. 40p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given on a study undertaken by a UK consultant group on the possible costs for wave energy devices based on mass production. Three devices are considered: Cockerell Raft, Lancaster Flexible Bag and the Salter Duck. Some concepts are proposed for the approach to manufacture which need to be adopted if wave energy devices are to be produced at the lowest cost.

36102 **(ETSU-WV—1628-Pt.1) Study on the assessment of costs for installing and maintaining mooring systems for wave energy devices.** (UKAEA Harwell Lab. Energy Technology Div.). Sep 1980. 238p. (SO—4923). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The results of a theoretical study to assess the costs of installing and maintaining mooring systems for floating wave energy devices proposed to be placed, in 60m of water, west of the Hebrides are presented. The hypothetical device considered is kept on station by 'mooring systems' developed during the study and designed to withstand a highly compliant system with relatively low forces, a highly restrained system with consequential high forces, and an intermediate system. Based on the limited design criteria submitted, the scope of work includes conceptual design of practical mooring systems and selection of a preferred solution for each of the three conditions. For each of these solutions the installation procedure and resource requirements have been developed, as were the total maintenance requirements expected over the design life of thirty years. Finally, budget cost estimates on the hardware, installation and maintenance for each system per device have been developed.

36103 **(ETSU-WV—1632-Pt.1) Energy analysis in the assessment of the U.K. wave energy programme, 1978.** Harrison, R.; Jenkins, G.; Mortimer, N.D. (UKAEA Harwell Lab. Energy Technology Div.). Jun 1980. 88p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Energy workshop report no. 18.

It is argued that by using energy analysis, the energy element in the costs for wave energy systems and the inflationary effects of price rises can be directly determined. The energy input to energy output ratios are evaluated for five wave energy devices. Only one has a value of less than unity and hence satisfies the basic criteria of energetic viability. It is argued that these results raise serious questions about the rationality on continuing with major funding of the UK wave energy programme.

36104 **(ETSU-WV—1637-Pt.1) Quasi-static analysis of wave loadings on spine-based wave energy devices.** Lockett, F.P.; Peatfield, A.M.; West, M.J. (UKAEA Harwell Lab. Energy Technology Div.). Feb 1980. 41p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A report is given on the Wave Energy Research Programme at Lanchester Polytechnic. Results are presented for both theoretical and experimental scale models for wave loadings on circular and rectangular spines of various lengths. The results are in good

agreement over the operational wave range for the 1/50 scale model and for the more limited data on the 1/10 scale model.

36105 (ETSU-WV—1649-Pt.1) Operation, control and monitoring of a 2GW wave energy scheme. Summary. Buchanan, G.; Jordan, J.R.; Whittington, H.W. (UKAEA Harwell Lab. Energy Technology Div.). May 1982. 13p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A report is given on the design of a control system to be used in conjuction with a 2 GW offshore wave energy device. The system control is performed by a shore based computer which is the link between the grid and the wave energy station. The data flow between the main computer and the sea based computers sited on the wave energy devices is described. Recommendations are made on control, data collection, telemetry and data acquisition.

36106 (ETSU-WV—1666-Pt.1) Validation and interpretation of directional wave observations with the Marex buoy. Final report. McCartney, B.S. (UKAEA Harwell Lab. Energy Technology Div.). Feb 1984. 17p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This contract funded NERC (IOS) to assess the technical performance of a new directional wave buoy (S100) produced by Marex, and to interpret directional data obtained at its proposed location west of South Uist. Early intercomparisons at Freshwater Bay, I.O.W., indicated inadequacies in the buoy slope response. Modifications were made for the South Uist moorings. Faults in the Marex buoy compass signals prevented a successful intercomparison with the IOS pitch-roll buoy at South Uist. A thorough one-dimensional (heave) intercomparison between the Marex buoy and an IOS Datawell Waverider at the South Uist site was made over a 2 month period. In view of the lateness for W.E.S.C. purposes, UKAEA terminated the Marex contract prematurely and consequently this NERC contract. In view of the almost developed state of the Marex buoy, and since this buoy has good potential as a medium capability directional wave buoy between the Datawell Wavec and the EMI DB2 types, recommendations for its repair, completion and further critical evaluation are made.

36107 (GEC-ESL/R—81-85) Feasibility study on the design and operation of turbo-generating equipment for the Lancaster Flexible Bag wave energy converter. Vol. 1. Johnston, J.; Topham, H.G.; Mahadevan, D.M. (GEC Energy Systems Ltd., Leicester (UK); UKAEA Harwell Lab. Energy Technology Div.). Feb 1982. 152p. (ETSU-WV—1551-Pt.42). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Report commissioned by Wave power Ltd., Southampton (GB).

This report commissioned by Wavepower Ltd covers the performance, material selection, aerodynamic design, stress analysis, layout, control and costing of the turbine, generator, exciter, auxiliary generator and essential auxiliary equipment for 500 Lancaster Flexible Bags. The aims were to combine as far as possible, high efficiency, the correct damping for the bags, a high integrity design suitable for a 25 year life, 10 years between bearing replacement and overhaul, minimum space, and minimum cost per turbine-generator unit. The control system optimizes flexible bag performance, and turbo-generator performance in low seas and limits power in high seas without introducing unnecessary kinetic losses within the closed circuit circuit system. Various methods of control are discussed and computer simulations are reported in full. The report includes sections on overhaul and maintenance condition monitoring, reliability, safe stress levels in a corrosive atmosphere, bearing life calculation, and proposals for future work.

36108 (NEL-ENER—14) Fatigue of 40 mm diameter six-strand wire rope in a seawater environment. (National Engineering Lab., East Kilbride (UK); UKAEA Harwell Lab. Energy Technology Div.). Mar 1984. 8p. (ETSU-WV—1579-Pt.1). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Rope samples were tested in two conditions, as received and pre-corroded in flowing seawater. There was no noticeable difference in endurance between the two conditions at the testing frequency of 4Hz. Four mean load levels were used and only at the longer endurances was there any detectable difference in endurance. Tests carried out at 0.16 Hz showed no significant difference in endurance from the 4 Hz tests. Correlation between this series of tests and fatigue tests on single wires, conducted by AERE Harwell, is inconclusive.

36109 (NEL-ENER—27) Cyclic testing of continuously wetted synthetic fibre ropes. (National Engineering Lab., East Kilbride (UK); UKAEA Harwell Lab. Energy Technology Div.). May 1983. 133p. (ETSU-WV—1664-Pt.1). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A laboratory study of the cyclic loading endurance properties of continuously wetted synthetic or man-made fibre ropes has been conducted as a guide to their suitability on mooring systems for wave energy recovery devices. The materials investigated were polyamides, polyester and polypropylene. Forms of construction studied were braid-on-braid, eight strand (square) and parallel lay. Rope sizes researched were 100 kN (10 tonf) nominal breaking force and up to 1.0 MN (100 tonf) nominal breaking force. All specimens were single leg. The test results indicate the superior bollard abrasion resistance and interstrand friction wear resistance of polyester and polypropylene over the polyamides. Trends, where observed, are also reported upon for the cyclic endurance performance of the forms of construction investigated. The improvements (or otherwise) in endurance effected by sheathing, coating and thimble protection of the eyes are also discussed.

36110 (STEV-NYEL—88-2) Computer assisted wave predictions based on the wave measurements by SMHI along the Swedish coast. Program description with examples. Soederberg, P. (SSPA Maritime Consulting AB, Goeteborg (Sweden); Statens Energiverk, Stockholm (Sweden)). Dec 1987. 72p. (In Swedish). (SSPA—8306-2). NTIS (US Sales Only), PC A04. Order Number DE88752962/JAW.

In this report a newly developed computer program called VAGPRED is presented. This program is working by interactive commands processing a search through the complete database. The wave conditions, including the wave spectral shape, can be predicted based on input of wind direction and speed. The expected variation up to four hours after the observation is also predicted. By running the program, (one example is included in this report), it has been shown that for a developed wave condition, when the combination of wind and waves is stable, no significant change is to be expected within a time period of four hours. If, however, the wave height is reduced, for instance by a wave energy absorber, in this example by 15%, it will take in the region of one or two hours to rebuild the wave amplitude.

17 WIND ENERGY

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 36541

36111 (NEI-NO—37) New wave direction buoy allows presentation of wave direction data in near real time. Ueland, G.; Barstow, S.F. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Oseanografisk Senter). May 1985. 13p. (CONF-8505286—2). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752840/JAW.

From 10. ARGUS conference; Kiel, F.R. Germany (22 May 1985).

A new wave direction buoy developed during 1983-84 is presented. The new design is built on IKUs experience with wave direction buoys over the last five years. A detailed presentation of the on-board data acquisition and processing system is given. Different methods for utilising the limited capacity af ARGOS are also discussed. Some results from the field tests are presented. 7 drawings.

1704 Economics

REFER ALSO TO CITATION(S) 36511

1706 Wind Energy Engineering

36112 (DOE/NASA/20320—75) Comparison of pressure distributions on model and full-scale NACA 64-621 airfoils with ailerons for wind turbine application. Gregorek, G.M.; Kuniega, R.J.; Nyland, T.W. (Ohio State Univ., Columbus (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1988. Contract AI01-76ET20320. 12p. (NASA-TM—100802). NTIS, PC A03;3. Order Number DE88009618/JAW.

The aerodynamic similarity between a small (4-in. chord) wind tunnel model and a full-scale wind turbine blade (24-ft tip section with a 36-in. chord) was evaluated by comparing selected pressure distributions around the geometrically similar cross sections. The airfoils were NACA 64-621 sections, including trailing-edge ailerons with a width equal to 38 percent of the airfoil chord. The model airfoil was tested in the OSU 6- by 12-In. High Reynolds Number Wind Tunnel; the full-scale blade section was tested in the NASA Langley Research Center 30- by 60-Ft Subsonic Wind Tunnel. The model airfoil contained 61 pressure taps connected by embedded tubes to pressure transducers. A belt containing 29 pressure taps was fixed to the full-scale section at midspan to obtain surface pressure data. Lift coefficients were obtained by integrating pressures, and corrections were made for the three-dimensional effects of blade twist and downwash in the blade tip section. Good correlation was obtained between the results of the two different experimental methods for angles of attack from -4{degree} to 36{degree} and aileron deflections from 0{degree} to 90{degree}. 4 refs., 11 figs., 1 tab.

36113 (EPRI-AP—5824) Altamont wind power plant evaluation for 1986: Final report. Smith, D.R.; Ilyin, M.A. (Pacific Gas and Electric Co., San Ramon, CA (USA)). May 1988. 85p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010643/JAW.

Pacific Gas and Electric Company (PG&E) purchases electric energy from the wind turbines in Altamont Pass, which has more wind driven electric generators than any other place in the world. The Electric Power Research Institute (EPRI) has sponsored a project to examine the technology and performances of these turbines, and their effects on the utility grid. This report gives some results from monitoring the wind resource. Trends in turbine design are presented. The performance of the wind farms in 1986 is analyzed, with an attempt to estimate the effects on energy production of turbine technical problems and a lower than expected wind resource in many areas. Also considered is the fit of the wind to utility need. Hour by hour data on wind farm output and PG&E area loads were compared, and loss of load probability (LOLP) computations were made to find the capacity credit or load carrying capabilities (LCC) of the wind farms. Some considerations is given to the problems, such as poor power factor, that the utility experience due to wind farm operation. Also the cost of wind energy is estimated.

36114 (HNEI—88-01) Baseline interface data from a wind turbine array intertied to a utility: Phase 1 report. Neill, D.R.; Huang, H.; Holst, B. (Hawaii Univ. at Manoa, Honolulu (USA). Hawaii Natural Energy Inst.). Mar 1988. Contract AC02-83CH10093. 106p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88009309/JAW.

The objective of this project is to obtain baseline physical, electrical and performance data which characterizes: (1) a wind turbine array interconnected with a utility at the point of interconnection, (2) the utility power generation and distribution system up to the point of array interconnection, and (3) the interaction between the two systems. This characterization included static as well as dynamic behavior. The chacterization study is for the Big Island of Hawaii and its utility system, the Hawaii Electric Light Company. The results are presented here.

36115 (NEI-DK—58) Report on adaption of heat pump to wind mill. Vestergaard, K.; Lund, V.; Pallesen, H.; Rasmussen, P. (Nordtherm, Nibe (Denmark); Miri Staal og Maskinvaerksted ApS, Brovst (Denmark); Produktudviklingscentret, Loegstoer (Denmark); Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark)). Jul 1987. 49p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752833/JAW.

The present project investigates the possibilities of adding a heat pump to a small electric power generating wind turbine. The heat pump is detached mechanically to the existing system and is thus using the wind turbine as a mechanic driving station. This construction avoids loss of power in transmission and conversion at up to 30% of the total power and small turbines (<10KW) have the greatest loss. These losses can be used in the heat pump by a direct detachment of turbine and heat pump. This preliminary investigation shows that as a purely heat producing turbine it is profitable, provided the energy source is available and the need is present. (SM).

36116 (RISO-M—2510) Wind energy applications for rural areas. Kocsis, K.; Petersen, H. (eds.). (Risoe National Lab., Roskilde (Denmark)). May 1987. 273p. (CONF-8705276—). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW.

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

The proceedings contain in the introduction a brief description of the FAO organization CNRE, European Cooperative Networks on Rural Energy, of which the work on wind energy application for rural areas is one of the activities. This description is followed by a summary of the workshop "Wind Energy Applications for Rural Area", held 14-16 May 1986 at Risoe National Laboratory, with brief reports on the papers and on the concluding session enumerating proposals agreed upon by the participants for future work. The papers of the workshop are reproduced mainly as delivered by the authors.

36117 (RISO-M—2601) Wind turbine test Bonus 95 kW. Schmidt Paulsen, U. (Risoe National Lab., Roskilde (Denmark)). Mar 1987. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752924/JAW.

The report describes standard measurements performed on a Bonus 95 kW wind turbine. The measurements carried out and reported cover information on power output, system efficiency, energy production efficiency of air brakes, structural dynamics, loads at cut-in and braking, and noise emission. (editor).

36118 (SAND—87-2461) Modal testing in the design evaluation of wind turbines. Lauffer, J.P.; Carne, T.G.; Ashwill, T.D. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010374/JAW.

This report reviews several techniques of low-frequency excitation used successfully to measure modal parameters for wind turbines, including impact, wind, step-relaxation, and human input. As one application of these techniques, a prototype turbine was tested and two modal frequencies were found to be close to integral multiples of the operating speed, which caused a resonant condition. The design was modified to shift these frequencies, and the turbine was retested to confirm expected changes in modal frequencies.

36119 (SAND—88-0152) Three-dimensional wind simulation. Veers, P.S. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009793/JAW.

A method for numerically simulating a three-dimensional field of turbulent windspeed (the "Sandia method") for use in the aerodynamic and structural analyses of wind turbines is presented. The required inputs are single point power spectral densities (PSDs) and the coherence function. Suggestions for appropriate

inputs and an example calculation are included. The simulation method is used to obtain "rotationally sampled" PSDs, which are compared with measurements obtained by Pacific Northwest Laboratories. The results show that the Sandia method is capable of producing simulations that agree with the measurements, especially when the coherence function is augmented from the usual form to include the ratio of spatial separation over height raised to the 0.25 power. The method is specialized for horizontal axis wind turbine analysis by phase lagging the simulations at each point in space so that wind speeds are simulated only when the turbine blade passes the point, reducing storage requirements and computation time by about an order of magnitude. For vertical axis applications, where interpolation will be required, the error induced by the interpolation is estimated and eliminated by the addition of white noise. 16 refs., 10 figs., 1 tab.

36120 (SAND—88-1360C) Liquid crystals for unsteady surface shear stress visualization. Reda, D.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880716—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010570/JAW.

From 1. national fluid dynamics congress; Cincinnati, OH, USA (24 Jul 1988).

Oscillating airfoil experiments were conducted to test the frequency response of thermochromic liquid crystal coatings to unsteady surface shear stresses under isothermal-flow conditions. The model was an NACA-0015 airfoil, exposed to an incompressible flow at a freestream Reynolds number (based on chord) of 1.14 x 10^6. Angle-of-attack forcing functions were sine waves of amplitude +- 10{degree} about each of three mean angles of attack: 0{degree}, 10{degree}, and 20{degree}. Frequencies of oscillation were 0.2, 0.6 and 1.2 hertz, corresponding to reduced frequencies of 0.0055, 0.0164 and 0.0328. Data acquisition was accomplished by video recording. Observations showed the liquid crystal technique capable of visualizing high surface shear stress zones over the stated dynamic range in a continuous and reversible manner. 11 refs.

36121 (STEV-VIND—87-19) Description of the computer program for the wind power station at Hoenoe. Landqvist, B. (Statens Energiverk, Stockholm (Sweden); Foersvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1987. 318p. (In Swedish). (FOA-C—20651-2.7). NTIS (US Sales Only), PC A14. Order Number DE88752855/JAW.

The report describes the total program for the computer at Hoenoe wind power station. Two versions are described, one for constant speed and the other for variable speed in a wide range. The control and supervisory parts are presented in detail, while remaining parts are described in a more superficial manner. The report treats also a model of the wind power station for simulation in an analog computer.

36122 (STEV-VIND—87-22) Calculation of the forces on the CTH windmill at Hoenoe prior to tests with yaw-control. Nygren, I. (Statens Energiverk, Stockholm (Sweden)). May 1987. 18p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752856/JAW.

Calculation of the forces in the primary shaft and on the blade joint with yaw-control on a 40 kW windmill.

36123 (STEV-VIND—87-23) Hoenoe testing station. Synchronous generator with frequency convertor for operation of windmill with variable speed. Carlsson, O. (Statens Energiverk, Stockholm (Sweden)). May 1987. 99p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752857/JAW.

This paper describes a variable speed ac-drive system, which consists of a synchronous generator with frequency convertor. This system allows a wide rage of turbine speed variation but the electrical machine can only work in generator mode. The electrical torque is fully controlled over the entire speed range. Results obtained with transient state calculations using computer models and laboratory tests were performed for the electrical system. Results from operating the test windmill have been carried out.

36124 (STEV-VIND—87-24) Investigation of a synchronous generator with a frequency converter for operation with variable speed at Hoenoe test station for wind energy research. Johansson, G. (Statens Energiverk, Stockholm (Sweden)). Jul 1987. 72p. (In Swedish). NTIS (US Sales Only), PC A04. Order Number DE88752858/JAW.

This paper describes the measurements and presents test results for variable speed operation of an electrical system consisting of a synchronous generator and a frequency convertor. The tests and measurements have been carried out both in the laboratory and on a windmill. At windspeeds lower than rated the turbine is operated at optimal speed and at higher windspeeds the power pitch-controled.

36125 Sandia National Laboratories 34-meter diameter vertical axis wind turbine test bed aerodynamic performance. Klimas, P.C.; Berg, D.E.; Stephenson, W.A. (Wind Energy Research Div., Sandia National Labs., Albuquerque, NM (US)). pp 85-86 of Seventh ASME wind energy symposium. Swift, A.H.P.; Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—). Contract AC04-76DP00789.

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

Sandia National Laboratories (SNL) is completing erection of its 34-meter diameter vertical axis wind turbine (VAWT) Test Bed near Amarillo, Texas. This versatile VAWT, rated at 500 kW in a 12.5 m/s (28 mile per hour) wind, has been designed to demonstrate aerodynamic, structural dynamic, and control strategies intended to improve the effectiveness of VAWT systems. The Test Bed rotor features blades of two distinct airfoil sections, one of which was designed specifically for the VAWT environment, and three separate chord length. The motivation for this configuration came from the need to provide positive aerodynamic stall regulation, high power coefficients in low and moderate winds, and modest material stress level. The curved equatorial portion features the SAND 0018/50 laminar flow (NLF) profile with a 91 cm (36 in) chord. This 18 percent hick symmetrical section was developed by SNL and G. Gregorek, Ohio State University. Its low drag at small angles-of-attack and sharp stall should contribute to high rotor power coefficients in modest winds and provide excellent stall regulation. The curved 7.6 m (25 ft.) lengths which adjoin the equatorial portion use a slightly modified version of this section with a 107 cm (42 in) chord. The modification gives the section a relatively sharper trailing edge and is dictated by the aluminum extrusion process used to fabricate the blades. The Reynolds number (based on blade chord) range for these sections is 1-4 million. The 10.7 m (35 ft) long, straight portions which join the blade to the central column use the NACA 0021 profile and have a 122 cm (48 in) chord. This profile was chosen for its gradual and gentle stall characteristics, as these blade elements operate over the widest range of angle-of-attack.

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36126 (CONF-880403—1) Cofiring of pelletized refuse-derived fuel with coal to achieve sulfur dioxide emissions requirements. Ohlsson, O.O.; Pearson, C.V.; Lazar, J. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012035/JAW.

From American power conference; Chicago, IL, USA (25 Apr 1988).

Processing of municipal solid waste with lime additives has produced a high quality, storable, fuel pellet. Earlier studies of the beneficial effect of lime addition to coal and of the cofiring of lime-rich refuse-derived fuel pellets with coal suggested cofiring these pellets with Illinois or Kentucky coals in order to reduce sulfur dioxide emissions. A series of burn tests were conducted at Argonne

National Laboratory in the summer of 1987 to verify the rate and conditions for optimum sulfur capture. Pellets with lime additions of 4-8% (by weight) were fired at 10, 20, or 30% (by ratio of heat input) with coal. This paper presents the results to date.

36127 (CONF-880699—5) **Studies on the use of propylene carbonate as a high-voltage insulator.** Clark, R.S.; Green, D.L.; Buttram, M.T.; Lawson, R.; Rohwein, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011786/JAW.

From 18. power modulator symposium; Hilton Head, SC, USA (20 Jun 1988).

A research program has been initiated to determine if propylene carbonate can be used as an insulator in the high-voltage accelerator field. Propylene carbonate, an industrial solvent and plasticizer, is a relatively high-dielectric constant (69) liquid with a low surface tension coefficient. The high-dielectric constant is attractive, because it leads to more compact pulse-forming lines (PFL) and the low surface tension lends itself to electrical component impregnation. Electrical properties, such as dielectric strength, resistivity, frequency response, and surface tracking, have been investigated. Initial tests show that propylene carbonate can be deionized to several MOmega-cm and that the electric field strength of plastic laminates immersed in it is several times higher than laminates immersed in oil. These tests reveal that a materials compatibility problem exists but it will not be so sever as to limit propylene carbonate usage in this field. These tests will determine if propylene carbonate can be used in advanced pulsed power systems to produce higher energy densities than are available with today's technology. Higher laminate field strengths will be especially advantageous in the design of high-voltage transformers. If the high-frequency response is sufficient, it may be possible to design magnetically switched pulse-forming lines with the switches in the same insulating fluid as the pulse-forming lines and thereby eliminate the oil-water barrier (interface) which is troublesome in present accelerators. The results of this investigative program will be presented.

36128 (CRIE-T—86087) **Basic design of load conditioner.** Ishikawa, Rikio; Iwahori, Tooru; Yokota, Tsutomu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1987. 44p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752536/JAW.

The load leveling measures of power demand is important for reducing the supply cost by effectively utilizing the power source equipment. Meanwhile, the development of new service on the demand side is also important for increasing the demand. It is expected to immediately develop the load conditioner, a low-cost small capacity of power storage system, by which the household stores the low-priced mid-night power in the battery and it consumes the power from the battery in the daytime. The basic components, specifications and problems of the lead-acid battery type load conditioner which can be installed in any households are presented. The main components include the charging rectifier, discharging self-excited inverter and battery. The specifications are as follows: the capacity is 2 to 8 kWh; the maximum output is 2 to 3 kW; I/O is of single phase, 100 V and 50 (60) Hz; and the target efficiency is 70% or more. The cost reduction of the AC-DC power inverter and lead-acid battery is indispensable for spreading the load conditioner. (15 figs, 8 tabs, 20 refs)

36129 (EPRI-AP—5702, pp 1.1-1.9) **Improving gas turbine reliability and availability.** Dolbec, A.C. (Electric Power Research Institute, Palo Alto, CA (USA)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

A discussion of the improvement of gas turbine reliability and availability is presented in outline form. Topics discussed include the characteristics of utility gas turbine procurement, EPRI's gas turbine reliability program and goals, how reliability can be specified, and gas turbine reliability in the 1990's.

36130 (EPRI-AP—5702, pp 2.1-2.22) **EPRI's project to develop guidelines for procuring high availability utility gas turbine systems.** Wills, R.E. Jr. (Creole Production Services, Inc., Houston, TX (USA)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

A guide for the procurement of high reliability gas turbine systems is presented. Information is presented on the scope of work, efforts to date, gas turbine exhaust thermocouples, gas turbine control instrumentation problems, gas turbine exhaust/duct work, and HRSG accessibility concerns.

36131 (EPRI-AP—5702, pp 3.1-3.9) **Customizing combustion turbine power plants to meet utility needs.** Moyers, E.K.; Sudduth, A.L. (Duke Power Co. (USA)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

Duke Power Company serves an area of 20,000 square miles with a population of 4,400,000. Its generating capacity of 15,855 MW is derived primarily from three nuclear stations and eight coal-fired stations, which provide base and intermediate load capacity. Peak load power is normally provided by 25 conventional hydroelectric stations and the 610 MW Jocassee pumped storage station. Duke currently has 599 MW of combustion turbine capacity. This capacity consists of aircraft derivative and small frame (i.e., GE Frame 5 and W 251 & 301) engines that were installed during the late sixties and early seventies. Planning studies for the past several years have indicated a need for additional peaking capacity beyond what is already in operation or under construction starting in the early to mid-nineties. Evaluation of technologies which are practical for use on the Duke system show that the technologies available to supply that peaking capacity included the use of combustion turbines. Based on these considerations, Duke management decided in late 1986 that a generic combustion turbine specification should be developed. The development process for that specification is described.

36132 (EPRI-AP—5702, pp 4.1-4.15) **Operating experience as an aid in procurement of gas turbines with improved RAM characteristics.** Knauf, C.L. Jr. Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

The importance of operating experience in the procurement of gas turbines with improved ram characteristics is discussed. Why operating experience is important, sources of help in gaining operating experience to aid in the procurement process, and the questions that should be asked in obtaining this help are discussed.

36133 (EPRI-AP—5702, pp 5.1-5.54) **Combustion turbine procurement: a turnkey approach.** Nikkels, H. (Anchorage Municipal Light & Power, AK (USA)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

Until the late 1970's, Anchorage Municipal Light & Power primarily utilized conventional design-purchase-construct contracting procedures to procure and install most of its generating facilities. Many of the problems with these projects could be attributed to lack of sufficient permanent staff to deal with consultants or to provide adequate site management. This situation encouraged inadequate engineering, weak estimates, poor job control, cost overruns and subsequent legal actions. To compound procurement problems, AML & P had responsibility of the projects, but final financial authority rested with the Municipal Assembly. In 1978, AML & P needed to purchase a new combustion turbine and waste heat cycle addition. Some successes in the mid 1960's encouraged AML & P to procure the equipment on a complete turnkey basis, with single source responsibility. The intent was to simplify engineering overview and project management to the point where it could be handled by a single qualified, permanent AML & P employee. To date, AML & P has used this process to purchase two combustion turbines in the 75 MW range, a waste heat addition for one of those units, steam cycle improvements, a major switchyard addition, and

numerous pieces of installed plant hardware. While any procedure can be improved, the projects were considered successful in that they met expectation, were completed on time, required little draw on a small utility's manpower resources, and had no cost overruns. What AML & P has learned in utilizing this method of combustion turbine procurement is discussed.

36134 (EPRI-AP—5702, pp 6.1-6.36) **Reliability, availability, and maintainability considerations for gas turbine procurement.** Dohner, C. (Electric Power Research Institute, Palo Alto, CA (USA)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

Reliability, availability, and maintainability considerations for gas turbine procurement are presented in outline form. Information is presented on EPRI advanced gas turbine reliability goals, forced outage data by plant areas, critical components, system criticality ranking, and the apportionment of goals and the application of techniques.

36135 (EPRI-AP—5702, pp 7.1-7.34) **How good are your specifications and what would you do differently in planning your next gas turbine power plant.** Zanyk, J.P. (Dow Chemical of Canada, Ltd., Sarnia, Ontario (Canada)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

Steps to go through in planning gas turbine power plants are discussed. The importance of reliability and avoidability is outlined. The following topics are discussed: harmonic stability problems, gas turbine specifications, specific items that are essential for good reliability and performance, compressor on-line/off-line washing, vibration and bearing temperature monitors, maintenance and warranties, by-pass exhaust stack, heat recovery steam generators, and data collection and performance monitoring.

36136 (EPRI-AP—5702, pp 8.1-8.19) **Chesterfield 7: combined cycle repowering with GE's 7F: procurement aspects.** Catina, J.L. (Virginia Electric & Power Co., Richmond (USA)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

Prior to 1985, the Virginia Electric and Power Company's primary generation expansion efforts had been directed toward the construction of 750 MW pulverized coal units in the mid-to-late '90's. However, in 1985 the company's 15-year load forecast indicated a dramatic increase in growth, signaling a need for additional generating capacity by the early 1990's. Thus, the company increased its investigation of alternative generating technologies. With the substantial risk that the difference between forecasted growth and demand growth will alter the feasibility of plans made today, flexibility is the key. Combined cycle systems offer considerable construction and operating flexibility and, along with contingency provisions for later coal gasification, are currently among the company's preferred alternatives. In 1985 the company began the first phase of a detailed study of repowering the two retired (1944 vintage; 800 psi, non-reheat) pulverized coal units at Chesterfield Station with 300 to 400 MW of combined cycle units with a planned completion data of 1994. The detailed finding of this first phase have been previously presented, and the results indicated that the most efficient, highest output and easily installed option was two GE 7F combustion turbines, combined with two HRSGs supplying 1450 psi reheat steam to two steam turbines. The study presented a conceptual design for this 400 MW system which could be phased in as two separate units. The original plan was to proceed toward a more detailed study of this option in 1986. However, by this time the 1986 Load Forecast indicated that 200 MW would be required in 1990, causing an abrupt acceleration of the plans for a new unit. The repowering of Chesterfield 1 and 2 units is discussed.

36137 (EPRI-AP—5702, pp 9.1-9.29) **Specification and purchase of gas turbine generator systems for high reliability and availability.** Schreiber, H. (Electric Power Research Institute, Palo Alto, CA (USA)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

The purchase and installation of a utility combustion turbine generator plant represents a sizeable capital outlay, and a commitment to expand operating and maintenance funds potentially far greater than the first cost, during its economic life over the next twenty or thirty years. Consequently, short cuts and expediencies forced by schedule constraints can be extremely detrimental and can have a profound effect not only on the life cycle cost of the equipment but on the cost of replacement power that may have to be bought due to its forced unavailability. An understanding of the effect of the trade-offs between first cost and life cycle cost is an important factor in making procurement decisions. The key ingredients of a good procurement are discussed.

36138 (EPRI-AP—5702, pp 10.1-10.15) **Control options in gas turbine procurement.** Quentin, G.H. (Electric Power Research Institute, Palo Alto, CA (USA)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

The instrumentation and control systems for new gas turbines are supplied by the manufacturer as an integral package with the new machine. This generally limits the options which the purchaser has open to him. The gas turbine user must be aware how the control system on a new turbine will impact his operation and maintenance procedures. Although the new control technology has much in its favor, and generally provides the same engine control functions, it will not appear the same to operators and maintenance technicians as older control equipment. Therefore, it is advisable to consider the instrumentation and control packages during the procurement process. The role of gas turbine instrumentation and controls is examined to provide some understanding of their impact on operation and maintenance. With this background, the buyer will have a better perspective on the options available to him in the procurement process, and how the best specifications may be put forward. Properly designed gas turbine controls can help to: maximize overall unit performance; sustain high levels of starting and running reliability; keep downtime at a minimum to assure availability; and, provide flexibility in meeting operating goals. These capabilities have become increasingly more important as gas turbines themselves have developed over the past 25 years, with increasing engine size and specific output.

36139 (EPRI-AP—5702, pp 11.1-11.18) **If money were no object.** Etheridge, V.W. (Salt River Project, Phoenix, AZ (USA)). Mar 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

In Gas turbine procurement: 1987 workshop: Final report.

How future gas turbine purchase specifications for the Salt River Project would be influenced by operating and maintenance experience over the past 16 years is discussed. The ideas expressed are the results of input from Plant Superintendents, Plant Engineers and Plant Operators. No attempt to justify the cost of any options on future purchases is made. There are so many variables that influence cost and return on investment that this must be done on a case-by-case basis. The Salt River Project (SRP) is a political subdivision of the State of Arizona. It was created to provide a reliable source of water for the farmers in central Arizona shortly after the turn of the 20th century. Money was borrowed from the federal government to build the Theodore Roosevelt Dam on the Salt River. Hydroelectric power generating equipment was installed in a powerhouse at the dam. Over the years the business has grown to include diesel engine driven generation, gas, oil and coal-fired steam generation, combustion turbines and most recently, a nuclear generating station operated by the Arizona Public Service Company. The construction and operation of the project are described.

36140 **(EPRI-AP—5815) Practical feasibility of advanced steam systems for combined-cycle power plants: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA)). May 1988. 112p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011432/JAW.

Over the past decade, advances in gas turbine design have lead to significant advances in the performance of simple cycle units. Higher turbine outlet temperatures with modern gas turbines provide an opportunity for improvements in the steam bottoming cycle of combined cycle configurations as well. This report covers the study, conducted under EPRI Project RP2052-2, to evaluate the practical feasibility of various steam cycle improvement approaches. The concept of "Fully Reserved Cost of Electricity" (FRCOE), developed for assessing the practical merits of proposed cycle improvement schemes, is described. FRCOE assigns cost penalties for the loss of availability or increased uncertainty due to any complexity introduced by these schemes. Experience with existing units incorporating advanced features is described, together with the technology limits to some of the advanced features. Practical feasibility assessments of steam bottoming cycle configurations, such as multiple steam pressures and reheating, are presented. Assessment of adjustments in steam cycle parameters included steam throttle pressure, superheater approach, pinch point, economizer approach and condensing pressure. Using data for a representative advanced gas turbine and conservative component availability estimates, the assessments found that lowering the pinch point has the greatest beneficial effects on the FRCOE. Favorable FRCOE results from two-pressure and nonreheat cycles. Only minor benefits acrue from lower superheater and economizer approaches, and throttle pressures above 1500 psi. There is no universally optimum system. At low fuel costs and low capacity factors, cycle improvements leading to loss of availabilility are not found to be economically justifiable. Conversely, at high fuel costs and capacity factors, these complex high performance cycles result in economically advantageous plants. Each plant application needs to be specifically analyzed. 3 refs., 17 figs., 8 tabs.

36141 **(EPRI-AP—5822) Improved maintainability for advanced gas turbines: Final report.** Sundstrom, E.J.; Carswell, R.; Hogg, W.H.; Zanyk, Z.P.; Aaron, H.E. (Dow Engineering Co., Houston, TX (USA)). May 1988. 104p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010347/JAW.

The maintenance history of GE Frame 7 gas turbines has been reviewed. Twelve users of this equipment were surveyed. The survey addressed the physical configuration of hardware and accessories necessary to achieve minimum downtime following a forced or scheduled shutdown. Guidelines identifying areas of concern were established to improve the maintainability of gas turbines in power generation service. These criteria were reviewed with the General Electric Company's 7001F gas turbine design team during September 1984 for applicability to this new model. Several major tasks were reviewed by The Dow Chemical Company's (DOW) maintenance technicians to indicate an industrial's approach to maintenance. Goals are provided for certain tasks complete with an example of a typical hot gas path inspection, and a typical major inspection. The examples are broken down in some detail with a Critical Path Map (CPM) included in the appendix. The availability of DOW's three Frame 7 E's since installation is shown with their complete list of outages. 7 tabs.

36142 **(EPRI-CS—5692) Slag monitoring for utility boilers: Final report.** Anson, D.; Barrett, R.E.; Litt, R.D.; Paisley, M.A. (Battelle Columbus Div., OH (USA); Central Electricity Generating Board, Nottingham (UK). Operational Engineering Div.). Apr 1988. 126p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009230/JAW.

This report provides a detailed description of commercially available slag monitoring techniques and some developing concepts for slag monitoring. Slag monitoring is currently being evaluated by several organizations as a means of controlling and optimizing sootblowers. The potential benefits from slag monitoring can represent significant savings in utility operating costs. Six types of heat flux meters are described as they are presently being used in utility boilers. These direct monitoring techniques determine local conditions within the furnace. Each application is described with current results and future plans. Boiler heat balance models provide an indirect technique for monitoring the general cleanliness/fouling of major boiler sections. Each model is described with current results at a representative installation. Several developing concepts of slag monitoring are described and evaluated. Four promising concepts, acoustic attenuation, a simplified heat balance model, sonic pyrometry, and ultrasonic pulse reflection, are recommended for further development and evaluation. 16 refs., 34 figs., 4 tabs.

36143 **(EPRI-CS—5729) Condenser performance test and back-pressure improvement: Final report.** Piskorowski, J.; Beckett, G.; Bell, R. (Heat Exchanger Systems, Inc., Boston, MA (USA)). Apr 1988. 99p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009448/JAW.

This document describes condenser performance test and analyses experiences. The testing was performed by Indianapolis Power and Light Company (IPL) on the Petersburg Unit 3 condenser. The initial testing revealed a performance deficiency. Modifications were made to the condenser, air in-leakage was reduced and the vacuum pumps were brought back to their original design capacity. Testing was reperformed after these activities and although a significant performance improvement was achieved deficiencies were still evident. Heat Exchanger Systems, Inc. (HES) was retained as consultants during this testing program. The Central Electricity Generating Board's (CEGB) Central Electricity Research Laboratory (CERL) acting as a subcontractor to HES were retained to perform an analysis of the Petersburg Unit 3 condenser using their EPOC computer code. The results of this analysis are also contained in this document. 3 refs., 48 figs., 3 tabs.

36144 **(EPRI-CS—5776) Multisystem corrosion monitoring in a cyclic reheat test facility: Phase 1.** Farrell, D.M.; Cox, W.M.; Gearey, D. (University of Manchester Inst. of Science and Technology (UK). Corrosion and Protection Centre Industrial Services). Apr 1988. 120p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009302/JAW.

The work described in this report was the first stage of an EPRI-sponsored corrosion investigation utilizing the CAPCIS electrochemical monitoring system installed in a cyclic reheat test facility on a flue gas slipstream at the Scholz Steam Plant of Gulf Power Company. The primary reasons for incorporating the continuous corrosion monitoring system in the cyclic reheat investigation were that unexpectedly high corrosion rates had been observed in earlier tests at certain locations within the test exchanger and the precise reasons for these high rates of attack were not well understood. The corrosion behavior was not typical of the limited service experience on full scale units and the reasons for this required clarification. Controlled temperature weight loss and electrochemical probes were installed in the unit in place of three of the 1-inch diameter heat exchanger tubes. The corrosion behavior of Inconel Alloy 625 over the temperature range 260{degree} to 120{degree}F (127{degree} to 49{degree}C) was evaluated at midstream and sidewall locations. The efects on corrosion of operational variables and cleaning procedures were also evaluated. The severe corrosion attack sustained on the Inconel Alloy 625 was proved to result from a combination of effects which included the flue gas flow pattern, local cool-spots within the unit and preferential locations at which ash deposits could accumulate. 5 refs., 50 figs., 17 tabs.

36145 **(EPRI-EL—5814) The eddy-current technique for nondestructive evaluation of generator retaining rings: Feasibility study: Interim report.** Elmo, P.M.; Nottingham, L.D. (Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). May 1988. 68p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010353/JAW.

An evaluation of the feasibility of using eddy current nondestructive inspection techniques to detect intergranular stress corrosion in generator rotor retaining rings was conducted by the EPRI NDE Center. Experiments were conducted using a bend-bar containing representative stress corrosion damage, a calibration block containing electrical discharge machined (EDM) notches, and four

retired retaining rings containing EDM notches and stress corrosion damage. An eddy current transducer transport was designed and fabricated to interface with an existing computer-controlled, two-axis positioner and digital eddy current data acquisition system. Test results of experiments performed with this equipment on the retaining ring test-bed provided experimental validation of the eddy current method's feasibility as a retaining ring inspection method. Details are given of the system and its performance under laboratory and simulated service-inspection conditions. 9 refs., 47 figs.

36146 **(EPRI-NP—5542) Flow velocity and turbulence measurements in a laboratory-scale steam generator model: Final report.** Yu, J.H.Y. (JAYCOR, San Diego, CA (USA)). May 1988. 75p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011424/JAW.

A series of velocity measurements was conducted in a 1/5 scale model Westinghouse D4 steam generator entrance section (waterbox). Single sensor constant-temperature hot-film probes aligned in sequence with x,y,z axes or various locations were used to obtain information on the velocity distributions in the waterbox. The linearized outputs were processed to obtain the mean, root mean square (rms), and spectral distributions of the components normal to the sensor axes. Some interesting features pertaining to the velocity and spectral distributions caused by the unique waterbox geometry were revealed. 25 figs., 4 tabs.

36147 **(EPRI-P—5788-Vol.1) Residual fuel oil quality: Market trends and management options: Volume 1, Analysis: Final report.** (Pace Consultants, Inc., Houston, TX (USA)). May 1988. 178p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011127/JAW.

The recent deterioration in the quality of residual fuel oil available to electric utilities has resulted in operating problems for several utilities. In light of these concerns, Pace Consultants has conducted a study sponsored by EPRI and several utilities to determine how quality has changed and to develop a reasonable forecast of future expectations. The study has shown that lower quality resid is due to sharply reduced demand, which has increased the concentration of cracked stocks in the average barrel of residual fuel oil. Other contributing factors include poorer crude oil quality and increased blending of sometimes incompatible stocks. Although future residual fuel oil quality is not expected to significantly worsen on average, certain market conditions may lead to periods of poorer quality. Utilities have attempted to cope with this problem in several ways. Measures include tightening specifications, altering operations, revising strategies and using additives. While these methods have been partially successful, no single solution has been completely effective. This report discusses several recommended procedures based on the findings of the Pace study. 65 figs., 31 tabs.

36148 **(NEI-DK—57) Decentral combined power and heat. Report from a seminar about decentral combined power and heat plants.** (Dansk Brandvaerns-Komite, Birkeroed). Mar 1987. 58p. (In Danish). (CONF-8702138—Absts.). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752832/JAW.

From Seminar on decentral combined power and heat plants; Ballerup, Denmark (4 Feb 1987).

This seminar had two main purposes - an illustration of the possibilities of Danish industry to develop knowhow and technology in connection with the power plants extension with decentral combined power and heat plants and an illustration of the technical, operational economy and environmental aspects attached to decentral combined power and heat production. The building program is kept within a power limit of 450 MW. The first phase of the program between 80-100 MW is for testing and demonstration. This report presents - in abstract form - central thermes from the debate which took its starting point at the lectures and the discussion. (SM).

36149 **(SVF—287) Energy management systems for heat production plants.** Wester, L.; Schuster, R. (Energiteknisk Utveckling AB, Trosa (Sweden); Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Nov 1987. 36p. (In Swedish). (ETU—6040-03). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752992/JAW.

This paper deals with different variables which influence the solution of the problem, different mathematical models that could be used to solve the problem etc. Two commercial systems are briefly described. Experiences from small heat production systems show that even very simple computational aids could be very valuable if they actually mean that calculations are carried through. In many cases today people avoid calculation because of incapability to do calculations or unfamiliarity with calculations. In three areas suggestions are put forward for further investigations. The areas are: - The performance of heat storage combined with production of electricity. - Investigation of the energy production systems in industries with high energy demands. - Information to/education of the staff of smaller production units to promote calculations. (authors).

36150 **A method for improving load turndown in fluidized bed combustors.** Brown, R.C.; Foley, J.E. (Dept. of Mechanical Engineering, Iowa State Univ., Ames, IA 50011 (US)). *Industrial and Engineering Chemistry Research;* 27: No. 1, 24-29(Jan 1988).

The authors investigate a new concept in the design of fluidized bed combustors that improves load turndown capability. This design is based on control of heat-transfer rate independent of combustion rate. The configuration under investigation consists of a central combustion bed surrounded by an annular fluidized bed that establishes overall heat-transfer rate from the inner combustion bed. The two beds are fluidized independently by separate air plenums. Experiments were performed to evaluate the usefulness of this device in improving load turndown. For a given combustor firing rate and air-to-fuel ratio, a wide variation in combustion temperature could be achieved by controlling the flow of fluidization air to the annular fluidized bed. In other tests, a load turndown ratio of 8.7 was achieved while combustion temperature was held constant.

36151 **Prediction and in situ measurement of the thermal conductivity of multiphase fouling deposits formed in direct coal-fired combustors.** Ross, J.S.; Ramezan, M.; Anderson, R.J.; Nagarajan, R. New York, NY; American Society of Mechanical Engineers (1987). 8p. (CONF-871234—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Technical Paper 87-WA/HT-6.

The fractional reduction in heat transfer from hot combustion gases due to the buildup of a fouling deposit layer on turbine blades in a coal-burning combustion turbine is determined primarily by the time-dependent thermal conductivity of the evolving deposit. These deposits are three-phase mixtures comprised of supermicron fly ash particles, vapor-deposited "glue"-liquid (usually molten alkali sulfates) and interstitial gas. The authors exploit here a rational approach to the prediction of the thermal conductivity of multiphase sintering deposits that incorporates additive resistance formulations yielding its dry-(no glue) and wet-(no gas) limiting values. Also included in the model is the sensitive response of deposit thermal conductivity to small glue volume fractions which are calculated on the basis of a model of self-regulated sticking. This theory has been applied to predict the change in surface temperature of a platinum target with deposit formation. Time-resolved measurements of target metal temperature obtained by multicolor optical pyrometry are used to monitor the effect of deposit layer growth on the inner surface temperature. Illustrative computations and preliminary comparisons with experimental data are presented here and tentative conclusions are drawn regarding the appropriateness of our descriptive/predictive model for deposit thermal conductivity.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 35598, 35599, 35603, 35606, 35607, 35612, 35614, 35615, 35626, 36126, 37419, 37683, 37702, 37709, 37776, 37777, 37778, 37779, 37851

36152 (BNL—41201) Potential reductions in US CO_2 emissions in 1995 and 2010 by technology improvements in electricity generation and transportation sectors. Cheng, Hsing C. (Brookhaven National Lab., Upton, NY (USA)). Apr 1988. Contract AC02-76CH00016. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010662/JAW.

By combining the current most efficient energy technologies in electricity generation and transportation sectors and their estimated market penetrations, the resultant possible fossil-fuel savings in the US in 1995 and 2010 were estimated. The improved technologies considered are either already commercially proven or are based on prototypes or advanced developments that could lead to commercialization in the near future. The baseline energy consumption projections based on the year-1985 energy technologies presently in practice were obtained from the reference case of the {open<-quotes}National Energy Policy Plan Projections to 2010{close<-quotes} (NEPP 1985). Two technology scenarios, designated as low and high estimates, were constructed to reflect the relative expectations of the performance and the rate of deployment of improvednew technologies. The resulting scenario should be regarded neither as indicating the upper limit on the potential reductions in the US CO_2 emissions nor as a forecast of what will happen. 10 refs., 2 figs., 17 tabs.

36153 (CONF-880403—2) Use of audibility analysis to minimize community noise impact of today's smaller generation facilities located near residential areas. Leibich, R.E.; Cristoforo, M.P. (Argonne National Lab., IL (USA); United Engineers and Constructors, Inc., Philadelphia, PA (USA). Environmental Engineering Dept.). 1988. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012059/JAW.

From American power conference; Chicago, IL, USA (25 Apr 1988).

This paper is intended to demonstrate practical applications of the Fidell-Horonjeff audibility model (2) to the analysis of power plant noise sources, such as cooling towers, transformers, pumps, ventilation fans, mobile diesel-powered yard equipment, loudspeaker systems, and even sodium-vapor-type outdoor lighting. Because plant-design engineers currently are relatively unfamiliar with the Fidell-Horonjeff model, the first part of this paper summarizes and reviews the model.

36154 (CRIE-T—86089) Literature data base of atmospheric diffusion (part 1). Senshu, Toshio; Fujita, Shin'ichi; Ichikawa, Yoichi; Komabayashi, Riichi; Sada, Koichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 31p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770187/JAW.

This survey is a part of data base investigation (started in 1985) by the Komae Research Laboratory of the Central Research Institute of Electric Power Industry; literatures on the atmospheric diffusion of exhausted smoke were selected respectively with an abstract as well as with an assessmant. This data base can be retrieved by the classification, title, author's name, magazine name, date of issue, and key words of the literature. For 1986, approximately 100 reports were assessed. Contents are: Analysis of wind and temperature field. Atmospheric diffusion model of exhausted smoke. Wind tunnel experiment. Long distance transportation of oxidant, etc. Acid rain, etc. These literature data are regarded useful for the power plant location together with the data concerning the influence of atmospheric contamination on health, influence of marine organisms, and off-shore diffusion data, etc. (4 tabs, 93 refs)

36155 (DOE/EIS—0125-F) Intertie development and use: Final environmental impact statement: Volume 4, Appendices. (USDOE Bonneville Power Administration, Portland, OR). Apr 1988. 602p. NTIS, PC A99;3. Order Number DE88011464/JAW.

Appenxix A contains supplemental data on socio/economic considerations as well as data on the natural resources environment. Information is arranged in the following order: geography/land use (Tables A.1 and A.2), power resources/resources mix (Tables A.3 through A.8), other uses of river systems (Table A.9), air quality (Tables A.10 through A.15), water quality/fish (Tables A.16 through A.19), and wildlife and vegetation (Tables A.20 and A.21).

36156 (DOE/METC—88/6084-Vol.2) Proceedings of the AR&TD [Advanced Research and Technology Development] direct utilization, and instrumentation and diagnostics contractors review meeting: Volume 2. Holcombe, N.T. (ed.). (USDOE Morgantown Energy Technology Center, WV; USDOE Pittsburgh Energy Technology Center, PA). Oct 1987. 405p. (CONF-871041—Vol.2). NTIS, PC A18/MF A01;1; GPO Dep. Order Number DE88001003/JAW.

From Advanced research and technology development direct utilization; Morgantown, WV, USA (13 Oct 1987).

The Advanced Research and Technology Development (AR&TD) Direct Utilization, and Instrumentation and Diagnostics Contractors Review Meeting was held on October 14-16, 1987, at the Sheraton Lakeview Conference Center in Morgantown, West Virginia. This meeting was sponsored by the US Department of Energy (DOE), Office of Fossil Energy, and the Morgantown and Pittsburgh Energy Technology Centers, and this year was hosted by the Morgantown Energy Technology Center. This annual meeting provides a forum for the exchange of information between DOE AR&TD contractors and interested parties and was attended by approximately 200 individuals from industry, academia, national laboratories, and other Governmental agencies. Papers were presented on ongoing research and research results relating to combustion phenomena, coal properties, cleanup, mineral-matter transformations, pyrolysis, atomization, instrumentation, erosion/corrosion, and deposition. A total of 12 technical sessions were chaired by staff from both the Morgantown and Pittsburgh Energy Technology Centers. Conference coordination was provided by the Conference Services staff of EG&G Washington Analytical Services, Inc., Morgantown Operations. The proceedings have been reproduced from camera-ready manuscripts furnished by the authors. They have not been refereed, nor have they been extensively edited. Papers have been entered individually into EDB and ERA.

36157 (DOE/PC/81006—T1) SO_2NO/sub x/ removal by $Ca(OH)_2$. Chu, P.; Rochelle, G.T. (Texas Univ., Austin (USA). Dept. of Chemical Engineering). [1988]. Contract FG22-85PC81006. 76p. NTIS, PC A05. Order Number DE88010148/JAW.

Previous workers have shown that simultaneous SO_2NO/sub x/ removal can be obtained in a dry scrubbing system with Ca(OH)/sub 2/produces more reactive solids and product recycle improve the reactivity of the solids toward SO_2. To test SO_2NO/sub x/ removal with fly ash and products recycle, bench-scale experiments with a packed bed reactor were performed at bag filter conditions. The most reactive solid fo NO/sub x/ removal was prepared by slurring $Ca(OH)_2$ with fly ash, $CaSO_3$, and NaOH. The best conditions for NO/sub x/ removal were high temperatures (tested up to 125{degrees}C) and high concentrations of SO_2 (tested up to 1500 ppM) and O_2(tested up to 20%). At the best conditions, NO/sub x/ removed in 1 hour was 3 to 4 moles per 100 moles $Ca(OH)_2$, compared to 5 to 10 moles SO_2 removed per 100 moles $Ca(OH)_2$. For the greatest SO_2 removal, it was necessary to prepare solids by slurring $Ca(OH)_2$ with fly ash and NaOH. The best SO_2 removal was obtained at higher relative humiditieslower temperatures. At these conditions, SO_2 removal in 1 hour was 60 to 80 moles SO_2 per 100 moles Ca $(OH)_2$, compared to 0.5 to 1 moles NO/sub x/ removed per 100 moles $Ca(OH)_2$. NaOH played an important role in SO_2 and NO/sub x/ removal - as an improvement to fly ash dissolution, as a deliquescent, and as possible catalyst for NO/sub x/ removal. When slurried with fly ash and NaOH, $CaSO_3$ substantially improved the solids reactivity toward NO/sub x/, but did not affect SO_2 removal. No optimum temperature for simultaneous SO_2NO/sub x/ removal was found. NO/sub x/ removal increased with temperature while SO_2 removal decreased. 32 refs., 24 figs., 16 tabs.

36158 (EPRI-CS—5734) Multisystem corrosion monitoring in FGD [flue gas desulfurization] systems, Phase 2. Farrell, D.M.; Cox, W.M.; Gearey, D. (University of Manchester Inst. of Science and Technology (UK). Corrosion and Protection Centre Industrial Services). Apr 1988. 125p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009447/JAW.

This report describes the second stage of an EPRI-sponsored investigation of on-line electrochemical corrosion monitoring at the R.M. Schahfer Generating Station, conducted by the Corrosion and Protection Centre Industrial Services, Manchester, UK. Controlled temperature weight-loss and electrochemical probes were installed in the post-reheater flue duct of a dual alkali FGD scrubber to evaluate the corrosion of Type 316L stainless steel over the temperature range 100{degree} to 160{degree}F. The effect on corrosion rate of transient operational conditions was also investigated. It was found, on this installation, that the maximum corrosion attack was sustained in the temperature range 125{degree} to 136{degree}F and was equivalent to a maximum pitting rate of the order of 4 mm/y. Surveys of the metal temperature in the post reheater and plenum chamber ducts revealed that many sections of the installation continuously operated within the critical range for maximum attack despite indications from conventional process instrumentation that the corrosion risk was minimal. It is concluded that the continuous multi-technique monitor is a useful tool with which to evaluate the corrosion behavior of materials exposed to attack by aggressive films of condensate. This approach can show when measures to prevent or minimize corrosion have been successfully implemented. The instrument provides the operator with a cost-effective method of obtaining a continuous indication of compliance within safe operating parameters. 57 figs., 11 tabs.

36159 (EPRI-CS—5782) Laboratory characterization of advanced SO_2 control by-products: Spray dryer wastes: Final report. Thompson, C.M.; Achord, R.D.; Blythe, G.M. (ICF Technology, Inc., Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1988. 233p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010995/JAW.

This report on the solid waste characterization of spray dryer wastes is the first in a series of five advanced SO_2 control waste characterization reports resulting from Task 2 of Research Project 2708-1. Task 2, Solid Waste Characterization, involved a detailed characterization of solid waste products based on literature and property determinations. The chemical, physical, engineering, and leaching properties of spray dryer wastes will be used to support the evaluation of waste management design and operation and potential utilization in Tasks 3 and 4 of this project. Results indicate that spray dryer wastes, although varied in chemical composition, can be handled in conventional collection, transportation, and storage systems designed for fly ash. These waste management systems will require designs that are capable of handling larger volumes and masses of dry waste materials. Chemical differences between spray dryer wastes and fly ash are greater than the physical and engineering property differences. Spray dryer wastes were nonhazardous and could be disposed in landfills. Utilization of spray dryer wastes as mineral admixture in Portland cement concrete and blended cements might be limited by chemical compositional requirements specified for reuse.

36160 (EPRI-CS—5849) Introduction to limestone flue gas desulfurization: Videotape workbook. (Electric Power Research Inst., Palo Alto, CA (USA); Radian Corp., Austin, TX (USA)). 1988. 32p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010695/JAW.

The workbook is designed to accompany the Electric Power Research Institute's (EPRI's) videotape, "Introduction to Limestone Flue Gas Desulfurization." To complement the videotape, the workbook provides additional information on limestone flue gas desulfurization (FGD) and a guide to sources of still more information. The videotape itself presents an introduction to the chemistry involved in a limestone FGD system. Following a description of a typical system, the basic chemical reactions that occur in this process are detailed. The most common operation problems in limestone FGD—low sulfur dioxide removal, low limestone utilization, and scaling—are reviewed with regard to how process chemistry can be controlled to alleviate these problems. This tape is an introduction only; future tapes will cover limestone FGD performance indicators and troubleshooting in more detail.

36161 (SNV—3147) High voltage power lines. Formation of noise and air pollutants. (National Swedish Environmental Protection Board, Solna). Mar 1986. 55p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752943/JAW.

This report on noise and ozone pollution from power transmission lines is based on measurements in Sweden and literature studies of North American experiences. Noise levels of 40-50 dBA are not uncommon at houses close to existing 400 kV lines in Sweden. Complaints are however few. For the future it is recommended that the noise level should be kept below 40-45 dBA at houses in areas with low noise levels and below 45-50 dBA in more densly populated areas. According to experiments performed, ozone production from power lines is only a very marginal environmental problem. With 17 refs.

36162 (SVF—263) Separation of mercury from filter dust. Hall, B.; Ljungstroem, E.; Lindqvist, O. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). May 1987. 57p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752987/JAW.

In experiments with flue gas (8% oxygen) and with metallic mercury added, (150/my/g/m/sp3/, 25 degrees C, 1 bar, ca. 18 ppb) about one third of the mercury is oxidized after 0.5 s residence time in the duct, after which time, the gas temperature has fallen to about 500 degrees C. The oxidized species formed is gaseous and easily reduced. The elemental mercury concentration also shows a tendency to fall along the duct which indicates that the oxidation process continues also at temperatures between 200 and 500 degrees C. The behaviour of the oxidation product is consistent with what is expected from the equilibrium and vapour pressure data for HgO. The reaction with hydrogen chloride appears to stop before the gas temperature has fallen below 500 degrees C. The final reaction product differs from that in the 'clean' experiments since all added mercury is recovered as total mercury along the duct. This shows that the compound formed is volatile and easily reduced which indicates that the product is HgCl/sb2/. When sulphur dioxide is added, almost all mercury is present as metallic mercury along the duct. A notable reduction of the concentration of metallic mercury is obtained when activated carbon (0.5-1.0 g/m/sp3/, 25 degrees C,1 bar) is added to the flue gas while the total mercury concentration is only slightly reduced. The carbon that was collected in the fabric filter at 150 degrees C contained 40-60 ppm mercury (/my/g Hg/g carbon) which corresponds to between 13 and 20% of the mercury added. (authors).

36163 (SVF—288) Condensation of flue gas - Description of installations and operation experience of plants fuelled by means of wood fuels. Dahlen, G.; Haegglund, L. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Nov 1987. 146p. (In Swedish). NTIS (US Sales Only), PC A07. Order Number DE88753352/JAW.

The experiences show that the systems operate satisfactorily today and that mainly there are two methods represented. One method is the indirect cooling of the fluegas in the heat exchangers and the other is direct cooling of the fluegas in the scrubber. At the wood-fired plants reported in this investigation where the predivision of dust takes place in the dust collection unit a sufficient amount of alcalic dust is received together with the fluegas which acts as a means of neutralization when condensing. At those plants where the purification of the fluegas takes place in an electric filter before the condensation an acid condensate is received. It has not been made clear whether this significant difference of the pH-value of the condensate depends on the equipment for the purification of the fluegas, the combination of the wood or the firing technique. There are corrosion problems at some plant but mostly normal kinds of stainless steel or plastic material, alternatively, can be used. Normally, it should be possible to add the condensate to the waste water net without purification or after the separation of the particles, provided it is neutral or slightly alcalic. At these plants the

costs of investments for the indirect methods are higher than those of the scrubber methods. (authors).

36164 **Filter unit for use at high temperatures.** Ciliberti, D.F.; Lippert, T.E. (to Dept. of Energy, Washington, DC). US Patent 4,735,638. 5 Apr 1988. Filed date 18 Nov 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A filtering unit for the filtering of particulates from a particulate-containing high temperature gas stream is described comprising a ceramic, tubular filter element, having a closed bottom and side walls and an open top at the upper region thereof, disposed in an aperture in a tube sheet. The walls of the tube sheet about the aperature have an inwardly extending flange thereon, with the open top of the ceramic, tubular filter element adjacent one surface of the tube sheet where filtered gases are discharged, and the closed bottom and side walls exposed to the area of the opposite surface of the tube sheet where a particulate-containing high temperature gas stream to be filtered is present. A ceramic spiral spring is provided at an end of the ceramic, tubular filter element to bias the upper region of the ceramic, tubular filter element into contact with the flange so as to seal the ceramic, tubular filter element to the flange on the tube sheet.

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REFER ALSO TO CITATION(S) 36161, 37776, 37777, 37778, 37779, 37780, 37780

36165 **(BNL—41289) Conductor loss in superconducting power transmission cables.** Forsyth, E.B. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-880466—3). NTIS, PC A02;3. Order Number DE88011414/JAW.

From Conference on superconductivity and applications; Buffalo, NY, USA (18 Apr 1988).

An analytic solution for the hysteretic loss in a Type II superconductor has been derived which is analogous to hysteretic loss in ferromagnetic materials subjected to weak alternating fields. In practice the losses in a practical conductor design are increased above the intrinsic loss due to such effects are grain size, surface roughness and the addition of other metallic components. The choice of conductor configuration also affects the losses. Flexible conductors, for example, exhibit further loss mechanisms due to circulating currents and proximity effects. Quantitative results are compared with theory. 30 refs., 6 figs., 1 tab.

36166 **(CONF-880701—1) Instrumentation system used to determine the effects of steep front short duration impulses on electric power system insulation.** Shaw, J.H. (Cooper Industries, Inc., Franksville, WI (USA). McGraw-Edison Power Systems Div.). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007483/JAW.

From IEEE Power Engineering Society summer meeting; Portland, OR, USA (24 Jul 1988).

This paper describes an instrumentation system used to acquire data on the effects of steep front short duration voltage impulses on electric power system insulations and equipment. The instrumentation arrangement, shielding and performance experiences are applicable to researchers who need to meter high voltage, high frequency transients. This research work is sponsored in part by the Office of Energy Storage and Distribution of the Department of Energy (DOE). 6 refs., 3 figs.

36167 **(CONF-880734—3) The HEMP [high altitude electromagnetic pulse] response of an overhead power distribution line.** Tesche, F.M.; Barnes, P.R. (E-Systems, Inc., Greenville, TX (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88006675/JAW.

From IEEE PES summer meeting; Portland, OR, USA (25 Jul 1988).

A study of the HEMP response of a realistic power distribution system was undertaken, and its results are described in this paper. This study involved the following elements: (1) the use of the new HEMP environment, (2) the use of a multiconductor coupling model, and (3) the measurement of the pulse response of an actual distribution transformer to permit the use of this data in the analysis.

36168 **(CRIE-T—86065) Corona cage study on prediction of AN and RI generated from HVDC trasmission line.** Nakano, Yukio; Sunaga, Yoshitaka. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1987. 43p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752540/JAW.

Corona cages have been in use as a means for predicting AN and RI generated from DC transmission lines. The static conductor surface gradient is used as the main variable in predicting corona performance of AC transmission line. However, this method cannot be applied to DC transmission lines because the effects of space charges resulting from corona discharge vary with the conductor configuration and the polarity arrangement. In this study, the maximum conductor surface gradient, Fmax, in the presence of space charge is introduced as the main variable and it is shown that the corona current, AN and RI at Fmax do not depend on the electrode systems around a conductor bandle. Based on these results, this report proposes a technique by which AN and RI generated by transmission lines can be predicted directly from results of corona cage tests. The introduction of the proposed method requires only the replacement of conductors in the corona cage, permitting low-cost, efficient prediction compared to conventional techniques. (12 figs, 6 tabs, 18 refs)

36169 **(CRIE-T—86067) Model study of the effects of wind on DC corona current. Wind tunnel experiment by means of reduced size model.** Amano, Yuji; Hirayama, Yoshiyuki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1987. 41p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770186/JAW.

A phenomenon wherein ion current charge voltage on the leeward side and ground-surface electric field significantly increase when wind blows across the DC transmission line, is desired to be quantitatively clarified for the prediction of ion flow electrification of the surrounding objects. An experiment was conducted by installing a DC testing model (1/50 size) in a large diffusion type wind tunnel. As a result, it was found possible to assess the dependency of corona current (generating from the respective wire) on the wind velocity by the ratio of wind velocity and the ion transfer velocity) regardless of the configuration of wires and poles. This indicates that the generated amount of corona current which is the basic amount for predicting the ion flow electrification in the DC power transmission wires can be accurately predicted. (34 figs, 4 tabs, 17 refs)

36170 **(CRIE-T—86070) Protection and control method by using online data on distribution system (part 2). Network-recognition method for operation algorithm.** Yukihira, Kenzo; Inoue, Yukio; Miyauchi, Motomitsu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1987. 23p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770189/JAW.

Such a high level of control as preventing of electricity stoppage at the time of accident can be made possible if remotecontrolled line switches with built-in voltage and current sensor are installed at multiple points in the distribution lines collecting the informations of switching (open or not) conditions and the electrical informations. At the substation, it needs a function to comprehensively judge the incoming informations in correspondence with the system. This report describes a method of data processing to carry out the judgement on the accidented sections and control instructions for the switches. If the distribution system is expressed by a node branch method and the connecting conditions are represented by a connecting matrix, the judgement on the accidented section can be easily made for more rapid response to the change in the line conditions. Basic elements for the switching operation at the time of accident are; (1) Detection of occurence of the accident. (2) Judgement on the accidented section. (3) Search for the connection

switch. Operation of switches is based on the combination of these switches. (10 figs, 3 tabi, 2 refs)

36171 **(CRIE-T—86071) Non contactive detection method for abnormal power equipments.** Kanamaru, Yoshiaki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1987. 39p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752539/JAW.

Electric power companies have been carried out development of sensors to serve for protection of power equipment. However, most of them are of a contact type and therefore, a trouble with them would force the equipment to be stopped. This report proposes an electric wave sensing technique for detecting abnormality in equipment. The technique measures partial discharge waves. Laboratory experiments of partial discharge wave detection are made using IEC standard electrodes. Field performance demonstration tests are also be made for the detection of partial discharge waves from a test transformer installed in the UHV Shiobara test station of Central Electric Power Research Institute. Results are used to determine the feasibility of commercialization of the technique. As a result, it is revealed that the proposed differential extraction type power equipment abnormality detection technique serves to detect electric waves resulting from partial discharge. It is most likely that further studies on quantification of detected waves and patterning of electric wave spectra will make it possible to provide a practical non-contact power equipment abnormality detection technique. (23 figs, 1 tab, 12 refs)

36172 **(CRIE-T—86072) Optimal planning method of underground distribution system.** Fukutome, Atsushi; Yoshimitsu, Tsukasa. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1987. 39p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770190/JAW.

The underground distribution is recently made systematically, and the systematic method of underground distribution system suitable for the area in which a number of high tension and low tension power demand were complicated was developed by applying the network optimization method to utilize for the planning of the reasonable underground distribution. Topological characteristics of roads could be inputted very simply as the mapping informations and could be represented precisely as a network. Main parameters such as location of feed points etc. could be modified easily on the CRT display, through the discussion with designers. Detailed designs except main parameters were formulated as the problems to resolve optimal cable route, that is, the shortest path (or minimum cost) and determined automatically. Analysis and evaluation of the investment cost could be simplified. The effect was confirmed by the computerized simulation applying this model to a standard city block. (24 figs, 9 tabs, 2 refs)

36173 **(CRIE-T—86075) Experimental study of shielding against lightning in winter season (Part 2).** Aihara, Yoshinori; Shindo, Takatoshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1987. 38p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752538/JAW.

In an effort to develop a theory for shielding against lightning in winter, model experiments are made for cases where transmission lines or tall structures under a uniform thundercloud are to be shielded against lightning by means of a lightning conductor tower. Major results obtained are as follows. Under a plane electrode which simulates a thundercloud, the flashover ratio of a wire conductor (model transmission line) is lower than that of a rod conductor (model lightning conductor tower). In this case, the flashover ratio of the wire conductor becomes greater as the distance from the rod conductor or the gap length decreases. When two rod conductors with different diameters are placed under a plane electrode, the flashover of the thicker rod (model tall structure) is lower than that of the thinner one. Based on these results, empirical equations are derived for the discharge rate for wire and thick rod conductors. An equation is also derived which gives the maximum height of a model transmission wire that can be shielded by the model lightning conductor tower. (21 figs, 2 tabs, 9 refs.)

36174 **(CRIE-T—86076) Temporary overvoltage flashover characteristics of contaminated insulator string under fog condition.** Takasu, Kazuhiko; Imano, Yoshio. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1987. 36p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770188/JAW.

A flashover test was conducted by a fog method which simulated the natural moist condition by installing a short time AC overvoltage generating unit. The results are as follows. (1) Time before the flashover of contaminated insulator tends to get shorter with higher overvoltage, and the minimum characteristics of the salt-contaminated insulators are constant regerdless of the type or degree of contamination. (2) AC conventional switching impulse voltage resistance of the contaminated insulator decreased by 15% in comparison with a switching impulse alone and multiplicity was 1.8 times of AC voltage wave height in the fog. (3) If duration time of overvoltage is less than 0.1 sec, the length of the insulator can be shortened by 10% in comparison with the conventional anti-contamination design method. (19 figs, 7 tabs, 18 refs)

36175 **(CRIE-T—86077) Natural contamination test of insulators with DC voltage energization at inland areas.** Takasu, Kazuhiko; Shindo, Takatoshi; Matsuda, Kyuichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1987. 41p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752537/JAW.

The contamination characteristics of the insulator energized with DC voltage and the generation of leakage current were measured for about five years in Yonezawa, Yamagata Prefecture, hardly influenced by the briny air. This paper presents the investigation of the test results. The equivalent salt depositing density and the insoluble matter depositing density on the bottom surface of insulator exposed for a long time were approximately 0.01 and 0.06 mg/cm^2, respectively. The exposure time until the contamination on the top surface of insulator becomes almost steady in approximately one year for both depositions. The depositions on the insulators on the energizing and earthing sides were larger than that on the insulator in the middle. The equivalent salt depositing density on the insulator in the middle was almost equal to that on the non-energized insulator. The maximum leakage current on the insulator energized with DC voltage (energization intensity: 90 to 120 kV/m) was 2 to 3 mA and the annual quantity of electricity was approximately 200 coulomb. (18 figs, 15 tabs, 19 refs)

36176 **(CRIE-T—86080) Development of external cooling cryo-resistive cable systems (Part 2). Insulation characteristics on 66kV rated cryo-resistive testing cable.** Ishihara, Kaoru; Akita, Shige; Suzuki, Hiroshi; Ogata, Jun'ichi; Nemoto, Minoru. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1987. 36p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770191/JAW.

Cryo-resistive cable system was tested to demonstrate dielectric characteristics. Dielectric characteristics of 66kV cryo-resistive cable at the start of immersion cooling in the liquid nitrogen were 2.25 specific dielectric constant and 0.18% dielectric loss which was less than 0.4%, the aimed value. Electrostatic capacity and dielectric loss tangent of dielectric characteristics under the applied voltage did not depended on the voltage and the dielectric loss was less than 0.4% through the temperature range from -170 to -190C. These values fulfilled the specifications on 275kV class cryo-resistive cable design. The tested cable passed the cable test on 66kV oil-filled cable (ac 90kV, 10min), but broken down at ac 110kV on the way to endurance testing voltage 130kV. The breakdown occurred due to the mechanical damage of cable insulator by bending and thermal contraction of the cable. It is necessary from these facts to develop flexible cable treminal and joint which can absorb the contraction to realize 275kV cryo-resistive cable. (19 figs, 7 tabs, 15 refs)

36177 **(CRIE-T—86118) Investigation of lightning protection characteristics on distribution line systems by means of observations of natural lightning. Measurements of induced lightning surges at Fukui Power Station of Hokuriku Electric Power Company (Part 4).** Yokoyama, Shigeru; Miyake, Kunihiko; Asakawa, Akira; Fukui, Sukenori; Nakamura, Masataka. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1987. 51p. (In Japanese). NTIS (US Sales Only), PC A04. Order Number DE88770192/JAW.

Lightning observation results in lightning seasons from 1984 to 1978 at Fukui Thermal Power Station were reported to clarify phenomena of the induced lightning and to demonstrate the effect of lightning protection facilities. Of 46 observed waveforms of lightning induced voltage, 18 waveforms were observed in response to waveforms of lightning induced current to the large chimney. 16 waveforms of lightning induced voltage with positive polarity in response to those of return stroke current with negative polarity and 2 waveforms of lightning induced voltage with negative polarity in response to those of return stroke current with positive polarity were observed. In both summer and winter lightnings, lightning induced voltage was caused by main discgarge and preceding lightning could be neglected. Distribution of lightning voltage along the distribution line length was observed for the first time. Lightning induced voltage peak values became lower in proportion to the distance from the nearest to the lightning induced voltage on the distribution line nearest the the lightning point. It is necessary to investigate the theoretical distribution along the line length and lightning influence on response characteristics of the distribution line to design more strict lightning resistant distribution line. (12 figs, 5 tabs, 12 refs)

36178 **(CRIE-Y—87005) Environmental design of power distribution facilities. Design study of pole-mounted equipments.** Yamashita, Yo; Wakatani, Yoshifumi; Yamamoto, Kimio. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 17 Sep 1987. 45p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752532/JAW.

When only wires were buried in the ground and other equipments such as circuit breakers and transformers were put on streets, the environmental design including distribution facilities (pole-mounted equipments) were investigated. For this study, concrete design drafts of pole-mounted equipments were prepared from the point of view making street amenity favourable, and the guide and procedure were clarified to make the suitable design for the street character. 50 design samples of pole-mounted equipments were drafted according to the visual evaluation points of distribution facilities and various design examples of street furniture. To match the equipment design to the street character such as street type on the basis of the application, street width and states of roadside trees, design objectives were classified into three factors such as harmony, amenity creating and symbolization. Visual effects and key words representing design viewpoints were used to make the design appropriate and to concrete the above objectives in the design. Further, five design drafts for street types were prepared and their effects and points to be considered were investigateed. (9 figs, 8 tabs, 13 photos)

36179 **(EPRI-EL—5735) A joint utility investigation of unexplained transmission line outages: Final report.** Beard, S.J.; Wilder, S.E. (eds.); Sandhu, K.S.; Siegel, S.M.; Rash, H.W.; Stearns, R.D.; Baker, D.W.; Roppe, J.A.; Catching, P.W.; Paul, D.R.; Missen, R.J.; Nielson, J.D. (Sierra Pacific Power Corp., Reno, NV (USA); USDOE Bonneville Power Administration, Portland, OR; Pacific Power and Light Co., Portland, OR (USA); Idaho Power Co., Boise (USA)). May 1988. 206p. Research Reports Center, Box 50940, Palo Alto, CA 94303. Order Number TI88010346/JAW.

An investigation into unacceptably high rates of unexplained outages on 345-kV guyed delta transmission lines with V-string insulators in western high desert areas was conducted. The large bird excrement stream theory and the wetted insulator contamination theory were examined to determine what contributions, if any, each had on the unexplained outage rate. Two tower treatments, a bird discourager and extra insulation, were installed on 42 miles of SPPCo transmission line. Unexplained outage data were gathered for 4 years and analyzed to compare the outage performance of untreated, bird discouraged, and extra insulated towers. Extra insulation was found to be an effective treatment for reducing the number of outages. Large birds were inventoried to ascertain the effectiveness of the bird discourager and investigate relationships between bird use and outages on transmission lines. No relationship was found. Local soils, particulate matter in the atomosphere, and contamination on insulators were sampled and analyzed to determine sources of contamination and ESDD levels. Staged tests were performed to evaluate the contamination performance of insulator strings, and weather data were gathered to assess potentials for contamination wetting during the year. A relationship between contamination and outages was identified as probable, but less likely during the hot, dry months of the year. For existing lines in similar environmental areas, 20--25% higher insulation levels are recommended as a means of reducing unexplained outages. For future transmission lines in high desert environments, utilities should consider a more conservatvie approach to line designs, such as increasing insulation levels and providing wider minimum air gap clearances within tower windows. 47 refs., 40 figs., 18 tabs.

36180 **(EPRI-EL—5798-Vol.1) The small signal stability program package: Volume 1, Program package development.** Kundur, P.; Rogers, G.J.; Wong, D.Y. (Ontario Hydro, Toronto (Canada)). May 1988. 178p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010345/JAW.

This report describes the theoretical background of the small signal stability analysis of power systems as embodied in the two programs MASS (multi-area small signal stability) and PEALS (program for eigenvalue analysis of large systems). These programs form, together with a data base program, a Small Signal Stability Package (SSSP) which can be applied to a broad range of stability programs. MASS is a program which forms the state matrix of an interconnected power system and performs an eigenvalue analysis, using the QR technique, on this matrix. PEALS determines, one at a time, those eigenvalues of the power system associated with the rotor angles of the synchronous machines. The basic algorithm used in PEALS was developed under EPRI RP 744-1. However, the modelling and network solution techniques used in PEALS have been newly developed to ensure complete compatibility with MASS and to enable systems having up to 12,000 bus to be studied. In both MASS and PEALS user defined models for excitation systems and dc controls enable the programs to be applied to a wide range of practical power systems. 3 refs., 38 figs.

36181 **(EPRI-EL/EA—5443-Vol.2) Analysis of polychlorinated dibenzofurans and polychlorinated dibenzo-{ital p}-dioxins in transformers and capacitors: Volume 2, Formation of PCDF [polychlorinated dibenzofurans] and PCDD [polychlorinated dibenzo-{ital p}-dioxins] in Askarel and contaminated mineral oil equipment: Final report.** Cooke, W.M.; DeRoos, F.L. (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1988. 78p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920261/JAW.

A study was conducted by five independent laboratories to evaluate methods for the measurement of trace levels of polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzo-p-dioxins (PCDDs) in utility dielectric liquids. Each laboratory evaluated a different analytical method. The method evaluated by Battelle involved spiking with labelled internal standards, analyte enrichment by column chromatography/high resolution mass spectrometry (HRGC/HRMS). Baseline analyses of five dielectric fluids were conducted by each laboratory as an initial test of their methods. The variability of results between the five methods was within expectations, and the five methods were deemed suitable for round robin evaluation. The in-service liquids used in this study were found to have relatively low levels of PCDDs and trace amounts of PCDF. Liquids from transformers with more than 25 years of service had higher PCDF levels than liquids from newer transformers. Liquids from utility appliances exposed to thermal and electrical stresses did not have elevated PCDD or PCDF levels. PCDF levels increased as the Aroclor number (and relative amount of chlorination) increased. 1 fig., 22 tabs.

36182 (IVO-B—04/87) Withstand voltage of slightly polluted insulator chains in humid weather conditions. Aroranta, M.; Lahtinen, M. (Imatran Voima Oy, Helsinki (Finland)). 1987. 59p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752818/JAW.

The aim of this study is to find the probability of flashover for slightly polluted insulator chains at normal working voltage level. The conditions favourable to flashover were examined by varying the atmospheric condition in the test room. The main result of this study is perhaps the verification of the doubt for remarkable flashover probability even at normal working voltage level and in slightly polluted conditions.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 36315, 36383, 36505, 37364, 38971

36183 (IAEA-TECDOC—431) Low-temperature nuclear heat applications: Nuclear power plants for district heating. Report of an advisory group meeting held in Prague, 23-27 June 1986. (International Atomic Energy Agency, Vienna (Austria)). Aug 1987. 77p. (CONF-8606395—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88701816/JAW.

From Advisory group meeting on low-temperature nuclear heat applications: nuclear power plants for district heating; Prague, Czechoslovakia (23 Jun 1986).

The IAEA reflected the needs of its Member States for the exchange of information in the field of nuclear heat application already in the late 1970s. In the early 1980s, some Member States showed their interest in the use of heat from electricity producing nuclear power plants and in the development of nuclear heating plants. Accordingly, a technical committee meeting with a workshop was organized in 1983 to review the status of nuclear heat application which confirmed both the progress made in this field and the renewed interest of Member States in an active exchange of information about this subject. In 1985 an Advisory Group summarized the Potential of Low-Temperature Nuclear Heat Application; the relevant Technical Document reviewing the situation in the IAEA's Member States was issued in 1986 (IAEA-TECDOC-397). Programme plans were made for 1986-88 and the IAEA was asked to promote the exchange of information, with specific emphasis on the design criteria, operating experience, safety requirements and specifications for heat-only reactors, co-generation plants and power plants adapted for heat application. Because of a growing interest of the IAEA's Member States about nuclear heat employment in the district heating domaine, an Advisory Group meeting was organized by the IAEA on "Low-Temperature Nuclear Heat Application: Nuclear Power Plants for District Heating" in Prague, Czechoslovakia in June 1986. The information gained up to 1986 and discussed during this meeting is embodied in the present Technical Document. 22 figs, 11 tabs.

36184 (INIS-mf—11110) Conference contributions to Session II. (Ingenieurhochschule Zittau (German Democratic Republic)). 1987. vp. (In German). (CONF-8704277—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780071/JAW.

From 8. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (22 Apr 1987).

IHZ Wissenschaftliche Berichte.

Separate abstracts were prepared for the individual papers in this report. (JDB)

36185 (INIS-mf—11153, pp 9-24) 1. Nuclear power - history, the present and prospects. Barabas, K. 1987. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780081/JAW.

In Nuclear power. CAEC lecturers' manual.

Briefly characterized is the development of nuclear power in the world and in the CSSR. Tables are presented showing the values of the total capacity of nuclear power plants in the individual countries, this of plants in operation and under construction, by 31st December, 1985. Briefly outlined are potential applications of nuclear power in district heating. Two variants are shown of prospective development of installed capacity in the CSSR and of the share of the individual types of power plants till the year 2030. It is envisaged that in that year the nuclear power plant capacity should be about 30,000 MW. (Z.M.).

36186 (NUREG—0020-Vol.12-No.3) Licensed operating reactors: Status summary report: Data as of February 29, 1988. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Apr 1988. 500p. NTIS, PC A21/MF A01 - GPO;1. Order Number TI88009913/JAW.

The US Nuclear Regulatory Commission's monthly Licensed Operating Reactors Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Information Resources Management, from the Headquarters Staff of NRC's Office of Inspection and Enforcement, from NRC's Regional Offices, and from utilities. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

36187 (NUREG—0020-Vol.12-No.5) Licensed operating reactors: Status summary report data as of 04-30-88. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). May 1988. 505p. NTIS, PC A22/MF A01 - GPO;1. Order Number TI88011371/JAW.

This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States. The percentage computations, Items 20 through 24 in Section 2, the vendor capacity factors on page 1-7, and actual vs. potential energy production on page 1-2 are computed using actual data for the period of consideration. The percentages listed in power generation on Page 1-2 are computed as an arithmetic average. The factors for the life-span of each unit (the "Cumulative" column) are reported by the utility and are not entirely re-computed by NRC. Utility power production data is checked for consistency with previously submitted statistics. It is hoped this status report proves informative and helpful to all agencies and individuals interested in analyzing trends in the nuclear industry which might have safety implications, or in maintaining an awareness of the US energy situation as a whole.

36188 (NUREG/CR—5038) Optimization of the control of contamination at nuclear power plants. Khan, T.A.; Baum, J.W. (Nuclear Regulatory Commission, Washington, DC (USA); Brookhaven National Lab., Upton, NY (USA)). May 1988. Contract AC02-76CH00016. 145p. NTIS, PC A07/MF A01 - GPO;1. Order Number TI88011800/JAW.

A methodology is described for the optimization of the actions taken to control contamination. It deals with many aspects of contamination, such as the monetary value assigned to a unit of radiation dose, the treatment of skin and extremity dose, and the inefficiencies introduced from working in a contaminated environemnt. The optimization method is illustrated with two case studies based on cleanup projects at nuclear power plants. Guidelines for the use of protective apparel, and for monitoring radiation and contamination at various levels of contamination are presented. The report concludes that additional research is required to quantify the effect of a contaminated environment on work efficiencies.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 35902, 36206, 36224, 36283, 36291, 36356, 36384, 36390, 36391, 36397, 36399, 36421, 36424, 36427, 36428, 36429, 36430, 36443, 36450, 36504, 37358, 37771

36189 (EPRI-NP—5775) Environmental effects on components: Commentary for ASME Section 3: Final report. Copeland, J.F. (Electric Power Research Inst., Palo Alto, CA (USA); Structural Integrity Associates, San Jose, CA (USA)). Apr 1988. 76p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009225/JAW.

This report presents general light water reactor experience and guidance summaries for potential service degradation mechanisms not explicitly covered by ASME Section III Code design requirements. Specifically, the damage mechanism description and experience; material selection, treatment and testing; operation and design limitations; and mitigating actions and remedies are summarized for prominent degradation mechanisms based on a review of the literature and industry experience. Emphasis is placed on relatively well-known problem areas based on industry experience, but is not meant to exonerate additional areas of concern which may emerge in the future. This guidance provides summaries and references as starting points for more detailed, case-by-case evaluations of specific applications.

36190 (EPRI-NP—5794) Catalytic methods of deoxygenating water: Final report. Balakrishnan, P.V.; Chuang, K.T.; Fletcher, J.W.; Suppiah, S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Apr 1988. 92p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009304/JAW.

As part of a programme on the optimization of pressurized water reactor (PWR) secondary side water treatment, methods of reducing the oxygen concentration from the feedwater without the use of toxic chemicals or chemicals that may produce undesirable by-products was sought for. Hydrogen was identified as such a chemical. Gamma radiation and catalysis were studied as means of promoting the reaction between oxygen and hydrogen, to form water with no byproducts. Two types of wet-proofed catalysts—the random bed and the ordered bed catalysts—were developed and tested under two modes of operation—liquid phase and gasliquid phase. Oxygen reduction down to concentrations of 1 ppB or less was achieved. Analytical models were developed for the processes from kinetic studies. Equations for use in designing deoxygenators for steam generator systems were derived. Computer simulations and experimental studies showed that gamma irradiation in the presence of hydrogen reduced oxygen to the low ppB levels at rates corresponding to G({minus}O_2) values in the range 1.5 to 2 molecules100 eV gamma energy absorbed. The gamma source strength required for reducing oxygen concentrations to acceptable levels was estimated. The location of the deoxygenator in a steam generator system is discussed. 41 refs., 21 figs., 11 tabs.

36191 (EUR—11206) Technical status of the supersara project at its termination. Markovina, A.; Randles, J. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1987. 128p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753956/JAW.

On March 10th 1983 the Council of Ministers of the European Community adopted the decision to abandon the SuperSARA project. In the frame of this decision, the Management of the SuperSARA project formulated the guidelines to close the project, which included the preparation of the present final report. This report presents the final status of the project, which means that it reflects the situation in March 1983, with a few updates introduced shortly afterwards in conformity with the safety requirements which were being revised at that time. The aim of this report is to give a general description of activities which were carried on to implement the experimental programme and to illustrate some important achievements reached in specific areas. In addition, it is also intended to provide the access key to the documentation which was produced in the past years, so as to make the most significant technical material easily available for any possible future use.

36192 (FEI—1723) Technique for calculating changes in isotope composition using simultaneous iterations of neutron flux and concentration. Glebov, A.P.; Kalashnikov, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701964/JAW.

Technique for calculating changes in the isotope composition is described. Regular itterations of neutron flux are simultaneously used to refine concentrations of burnable isotopes during every compain moment. Efficiency of the technique is shown using as an example the results of one-dimensional calculations of cylindrical uranium-water cell with gadolinium burnable poison in the centre. 7 refs.

36193 (IWGATWR—1-1) First meeting of the International Working Group on Advanced Technologies for Water Cooled Reactors, Vienna, 18-21 May 1987. (Pt. 1). Summary report. (International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors). Dec 1987. 40p. (CONF-8705279—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702118/JAW.

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

The first meeting of the IAEA International Working Group on Advanced Technologies for Water Cooled Reactors was held in Vienna, Austria from 18-21 May 1987. Part I of the Summary Report contains the minutes of the meeting.

36194 (IWGATWR—1-2) First meeting of the International Working Group on Advanced Technologies for Water Cooled Reactors, Vienna, 18-21 May 1987. (Pt. 2). Summary report. (International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors). Dec 1987. 45p. (CONF-8705279—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW.

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

The First Meeting of the IAEA International Working Group on Advanced Technologies for Water Cooled Reactors was held in Vienna, Austria from 18-21 May 1987. The Summary Report (Pt. 2) contains the papers which review the national programmes in the field of Advanced Technologies for Water Cooled Reactors and other presentations at the Meeting. A separate abstract was prepared for each of the 10 papers presented at this meeting. Refs, figs.

36195 (IWGATWR—1-2, pp 9-10) **Light water reactor development in Finland.** Aalto, E. (Imatran Voima Oy, Helsinki (Finland)). Dec 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

36196 (IWGATWR—1-2, pp 11-19) **Status of French R and D for advanced light water reactors.** Nigon, J.L. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). Dec 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

Present PWRs lead to a significant reduction of electricity cost when compared to other sources. Then it seems reasonable to keep the main features of PWRs when looking for improvements of investment cost, of operating and fuel costs, of flexibility and of safety. Besides that we have to think about uranium conservation; if nuclear starts again in many countries, as we hope, the uranium

market could get into a crisis during the first half of the 21st century, and uranium shortage could become a reality. Advanced PWRs are also aimed at fissile material saving. The three French partners CEA, EdF and FRAMATOME decided to lead a three year programme 1984-1987. FRAMATOME in fact had started a little bit earlier, namely in 1982 (first publication in RNG - a French technical journal) and developed the RCVS, spectral shift convertible reactor core (for both Uranium and Plutonium fuel). FRAMATOME's effort is estimated to about 40.10^6 FF per year. EdF, R and D Division, is associated with this feasibility study. CEA performs an R and D programme, the objectives of which are: to support FRAMATOME for RCVS design; to explore a wider range of parameters in order to estimate the feasibility and the interest of tight lattice PWR cores. Simultaneouly, EdF is defining the preliminary specifications of "REP 2000" (future standard for French PWRs in the year 2000 and following); the objectives of REP 2000 are: load follow capacity; cost effectiveness; operation flexibility. FRAMATOME's RCVS and the CEA RSM feasibility study have to be considered in this context. The main objectives are: 1) To improve performances, safety and to minimise cost; 2) To save fissile materials according to a global strategy; 3) While minimum modifications of present PWR components will be accepted. The R and D budget for PWRs (outside safety) of French CEA is around 450 10^6FF per year.

36197 (IWGATWR—1-2, pp 19-21) **Research and development of French PWRs.** Dennielou, Y. (Electricite de France, Villeurbanne (France)). Dec 1987. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

36198 (IWGATWR—1-2, pp 24-28) **Present conditions to promote advancement of LWRs in Japan.** Miwa, T. (Nuclear Power Engineering Test Center, Tokyo (Japan)). Dec 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

36199 (IWGATWR—1-2, pp 29-32) **Swedish activities on advanced technologies for water cooled reactors.** Pedersen, T. (ASEA-ATOM AB, Vaesteraas (Sweden)). Dec 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

36200 (NUREG/CR—4219-Vol.4-No.2) **Heavy-section steel technology program semiannual progress report for April-September 1987.** Corwin, W.R. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 335p. (ORNL/TM—9593-Vol.4-No.2). NTIS, PC A15/MF A01;1. Order Number TI88008884/JAW.

The Heavy-Section Steel Technology (HSST) Program is conducted for the Nuclear Regulatory Commission (NCR). The studies relate to all areas of the technology of materials fabricated into thick-section primary-coolant containment systems of light-water-cooled nuclear power reactors. The focus is on the behavior and structural integrity of steel pressure vessels containing cracklike flaws. The program is organized into 12 tasks: (1) program management, (2) fracture methodology and analysis, (3) material characterization and properties, (4) environmentally assisted crack-growth studies, (5) crack-arrest technology, (6) irradiation effects studies, (7) cladding evaluations, (8) intermediate vessel tests and analysis, (9) thermal-shock technology, (10) pressurized thermal-shock (PTS) technology, (11) Pressure Vessel Research Users' Facility (PVRUF), and (12) shipping cask material evaluations. During this period, extensions were made to fracture-analysis codes, including the addition of more constitutive models and inelastic fracture criteria in the dynamic viscoplastic fracture version of the ADINA - ORMGEN-ORVIRT analysis codes at Oak Ridge National Laboratory (ORNL). Elastodynamic analyses and development work on viscoplastic fracture-analysis techniques were performed by ORNL and the Southwest Research Institute (SwRI) in support of the wideplate crack-arrest tests that are being performed by the National Bureau of Standards (NBS) for the HSST Program.

36201 (NUREG/CR—5082) **Simulation experiments on two-phase natural circulation in a freon-113 flow visualization loop.** Lee, Sang Yong; Ishii, Mamoru. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 54p. (ANL—88-1). NTIS, PC A04/MF A01 - GPO;1. Order Number TI88010402/JAW.

In order to study the two-phase natural circulaton and flow termination during a small break loss of coolant accident in LWR, simulation experiments have been performed using a Freon-113 flow visualization loop. The main focus of the present experiment was placed on the two-phase flow behavior in the hot-leg U-bend typical of B and W LWR systems. The loop was built based on the two-phase flow scaling criteria developed under this program to find out the effect of fluid properties, phase changes and coupling between hydrodynamic and heat transfer phenomena. Significantly different flow behaviors have been observed due to the non-equilibrium phase change phenomena such as the flashing and condensation on the Freon loop in comparison with the previous adiabatic experiment. The phenomena created much more unstable hydrodynamic conditions which lead to cyclic or oscillatory flow behaviors. Also, the void distribution and primary loop flow rate were measured in detail in addition to the important key paramaters, such as the power input, loop friction and the liquid level inside the simulated steam generator.

36202 (STUDSVIK/NF(P)—87/28) **Study of fission products and uranium oxide phases in a defective BWR fuel rod. Final report.** Jonsson, T. (Studsvik Energiteknik AB, Nykoeping (Sweden)). 15 Jul 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753591/JAW.

A defect rod from Ringhals 1 has been examined. The loss of cesium is 15-30% and locally at a cladding defect more than 60% of the inventory. These results are in good agreement with an earlier examination of a defect rod from the same fuel lot. The results also confirm earlier experience of large axial variation of the behaviour of cesium in a defect rod. In the study of various phases in the fuel, emphasis has been placed on optical studies, since radiation background from the sample together with delayed delivery of certain components for the microscope prevented satisfactory quantitative analysis by SEM. Beta autoradiography with an absorber seems to offer a promising method to study the Sr-90 distribution in fuel with a long decay time. It indicates a strontium loss of the same order of magnitude as for cesium. In an outer rim of the uranium dioxide close to a defect there is a differing phase which probably is a uranium oxide with higher oxygen content than UO_2.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 35809, 36189, 36191, 36192, 36193, 36194, 36195, 36196, 36197, 36198, 36200, 36201, 36283, 36291, 36301, 36331, 36332, 36352, 36353, 36354, 36356, 36370, 36373, 36388, 36390, 36391, 36393, 36394, 36399, 36403, 36404, 36405, 36406, 36407, 36408, 36409, 36410, 36411, 36412, 36413, 36414, 36415, 36423, 36424, 36426, 36427, 36428, 36429, 36430, 36433, 36435, 36436, 36443, 36448, 36450, 36773, 37030

36203 (CEA-CONF—9238) **Dynamic response of PWR vessel during a blowdown.** Guilbaud, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 6p. (CONF-870850—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753460/JAW.

From Seminar on extreme load design of future nuclear plant facilities; Paris, France (24 Aug 1987).

This paper presents a study of the behaviour of a 1300 PWR structures during the acoustical period of a blowdown accident, caused by a sudden break of the cold pipe at the outlet of the pump. The calculation gives displacements and pressures for many

points of the vessel. Besides it gives the reaction forces in internal supports and also the loading level reached in the support device of the vessel. This calculation was performed by the computer code TRISTANA, which uses a substructuration method on a modal basis. This simplified method reduces computing size and time for tridimensional problems involving fluid structure interaction and sometimes localized non-linearities. It has already been validated during the calculation of the HDR blowdown.

36204 **(CEA-CONF—9259) Mixed oxides fuels. Adaptation of PWR core and vessel to the mixed oxides fuels. The physical aspect in the conception of the plutonium assemblies.** Martin Deidier L.; Darraud, A.; Bergeron, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 15p. (In French). (CONF-8710325—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753465/JAW.

From SFEN/BNS meeting - technical session on nuclear fuel cycle; Paris, France (7 Oct 1987).

The use of mixed plutonium oxyde fuels (Mox) does not create a prejudice on the performances, manoeuvrability and flexibility of the reactor operation. In this paper, the authors recall the neutronic differences between the plutonium and the uranium and indicate the realized experiences made for qualifying the Mox fuel.

36205 **(CEA-CONF—9260) Malfunction tests and vibration analysis of P.W.R. internal structures.** Puyal, C.; Castello, M.; Dumortier P.; Carre, J.C.; Epstein, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 8p. (CONF-871013—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753466/JAW.

From 5. SMORN: international conference on reactor noise; Munich, F.R. Germany (12 Oct 1987).

To diagnose changes liable to occur in the vibration behavior of internals, it is important to understand the influence of changes in the mechanical properties of elements on the output signals obtained from neutron chambers placed out of core and accelerometers fixed to the reactor vessel. To do this, the effects of changes liable to occur in the hold-down springs and the flexures were simulated on the SAFRAN loop, using a representative hydroelastic mock-up. The results obtained experimentally on SAFRAN for different characteristics of the hold-down spring, which lies between the upper part of the core barrel and the vessel head, have been published. In this paper, we propose to present the results of the investigation of the fracture of one or more flexures which connect the cylindrical thermal shield to the core barrel. This work is in two parts: a) Computation based on a hydroelastic model using the substructuration computer program TRISTANA of the CASTEM system. b) Tests simulating flexure fracture: 1 - in air, for an understanding of the mechanisms involved; 2 - on the SAFRAN loop with a representative flow in order to estimate the strains liable to exist on the vibration signatures recorded on displacement transducers and accelerometers. Good agreement was observed between the computation results with the theoretical model employed and those obtained experimentally.

36206 **(CEA-CONF—9261) Analytical modal diffusion theory based on flux separability.** Segev, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 6p. (CONF-871101—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753467/JAW.

From California State Air Resources Board; Los Angeles, CA, USA (15 Nov 1987).

The theory provides for an iterative solution of the mathematical problem of generating the assembly-wise power distribution in a LWR through the solution of the 2-group, multidimensional, diffusion equation. The companion problems of assembly pre-homogenization and of pin power reconstruction are of no direct concern presently. The theoretical development stems from the assumption of flux separability in X, Y and Z. The assumption derives from the notion that separability holds in a great part of the interior of a LWR assembly. More important, well accurate power maps are generated with a code based on the theoretical develpment yielded by the basic assumption.

36207 **(EPRI-CS—5662) Condenser performance test and replacement tubing material evaluation: Final report.** Bell, R.J.; Hardy, C.D. (Heat Exchanger Systems, Inc., Boston, MA (USA)). Apr 1988. 164p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009450/JAW.

This document describes the experiences of a utility in evaluating condenser performance and in performing testing to identify and correct performance deficiencies and related problems. A comprehensive evaluation of the steam surface condenser performance at Kewaunee Nuclear Plant (KNP) was undertaken by Wisconsin Public Service Corporation (WPSC) in the first half of 1984. This evaluation was prompted by the projected need to retube the steam surface condenser. Stainless steel alloys were considered the only acceptable replacement candidates because of the contribution of copper to nuclear plant steam generator corrosion. All of the stainless steel alloys have lower heat transfer coefficients than the Admiralty brass tubing originally installed in the condenser. The potential impact on the unit heat rate coupled with apparent condenser performance deficiences led to this extensive analysis.

36208 **(EPRI-NP—5540) Experimental determination of turbulent buffeting effects in tube bundles: Final report.** Johnson, J.E.; Simonis, J.C. (Electric Power Research Inst., Palo Alto, CA (USA)). May 1988. 160p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010998/JAW.

Dynamic lift and drag force correlations for the first and second row of tubes of a square pitch tube array (P/D=1.44) are presented for upstream turbulence intensity and integral scale lengths. These correlations were developed from experimental testing of full scale heat exchanger tubes in water under controlled and measured turbulent flow conditions. Turbulent buffeting effects for upstream turbulence intensities up to 15% and scale lengths of {1/2} to 1 tube diameter are discussed.

36209 **(EPRI-NP—5555) Prediction of localized flow velocities and turbulence in a PWR steam generator: Final report.** Stuhmiller, J.H. (Electric Power Research Inst., Palo Alto, CA (USA); JAYCOR, San Diego, CA (USA). Engineering Services Group). May 1988. 176p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011529/JAW.

The Steam Generator Project Office (SGPO) of the Steam Generator Owners Group and Electric Power Research Institute has developed a methodology for prediction of steam generator tube buffeting and associated material wear. Turbulent buffeting of steam generator tubes causes low amplitude vibratory response which results in fretting wear at support locations. Concerns raised at the Zion Nuclear Power Plant regarding the useful life of their steam generators prompted this study, in which the SGPO methodology is applied to analysis of the Westinghouse Model 51 steam generator. The specific intent of this project was to calculate turbulent buffeting forces within the tube bank of an operating Model 51 steam generator as a first step in the overall SGPO tube vibration and wear prediction strategy. Attention is focused on flow in the vicinity of anti-vibration bars (U-bend region) and on the flow that leaves the downcomer to impact against peripheral tubes. Other projects utilized the buffeting forces calculated here to determine tube vibratory response, tube-support plate impact statistics, and material wear rates. Besides successfully calculating hydraulic buffeting loads within the tube bank, the present project has enhanced the SGPO methodology and has identified hitherto unnoticed flow phenomena that occur in the steam generator. Experiments have also been carried out to validate numerical computations of the steam generator flow field.

36210 **(EPRI-NP—5556) Numerical prediction of turbulence-induced steam generator tube vibration: Final report.** Stuhmiller, J.H. (Electric Power Research Inst., Palo Alto, CA (USA); JAYCOR, San Diego, CA (USA)). May 1988. 250p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011365/JAW.

This project investigates promising techniques for predicting turbulent buffeting of tubes leading to tube damage from wear

given overall steam generator geometry and operating conditions. The specified overall steam generator operating conditions are used in a model for the steam generator inlet region to evaluate local measures of incoming turbulent flow such as velocity, pressure, turbulence intensity and spectra. A range of models differing in degree of completeness may be used to calculate the incoming flow turbulence. The simplest of the three models is to use a thermal-hydraulic code such as EPRI's ATHOS or PORTHOS code to calculate the steady state flow field (u, v, w and p). Crude, empirical estimates for turbulence intensities and spectra may be deduced from the steady flow results. The best approach, which is chosen for the present study, is Large Eddy Simulation (LES) which gives detailed transient flow results that are in essence a complete description of incoming turbulence. LES results for turbulent flow in the steam generator inlet region provide the necessary local flow conditions for input into tube structural dynamic simulations. This project uses transient thermal-hydraulic analysis of flow within the tube bank to determine the instantaneous, circumferentially integrated force on each tube as a function of position along its axis. The resulting force component time histories provide a complete description of the force imposed on a rigid tube due to the incoming flow turbulence. Tube motion under the action of flow induced forces is determined from models of structural dynamics. This project models one-dimensional motion of the multispan tube including finite tube support clearances and the resulting tube-support impact force. 25 refs., 99 figs., 11 tabs.

36211 **(EPRI-NP—5712) Oxide-film compositions and morphology on Alloy 600 tubes from steam generators: North Anna Unit 1 and Point Beach Unit 1: Final report.** Lumsden, J.B. (Rockwell International Corp., Thousand Oaks, CA (USA)). Apr 1988. 47p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009222/JAW.

Films on alloy 600 steam generator tubing with IGA were characterized to assess the environmental conditions in which the films were formed and thus the environmental conditions which may have caused the IGA. Tubing was analyzed which was from a tube support crevice in the North Anna-1 steam generator. The film composition suggested that the environment at both the outside surface of the tube in the crevice and in the crack was in the range from mildly acidic to mildly alkaline. Boron was also observed in the cracks, indicating that the boric acid injected into the secondary water penetrated into the tube support crevice. The film on the outside surface of a tube removed from the tubesheet crevice of the retired Peach Bottom-1 steam generator suggested either a mildly alkaline solution or a thin liquid film surrounded by steam. The film compositions observed in the cracks of the alloy 600 tubing from Point Beach-1 indicated a caustic solution which increased in caustic concentration from the crack opening to the crack tip.

36212 **(EPRI-NP—5773) Signal processing for steam generator inspection: Interim report.** Jackson, P.S.; Endter, R.K.; Sapia, M.A.; Lareau, J.P. (Combustion Engineering, Inc., Windsor, CT (USA)). Apr 1988. 35p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010311/JAW.

Nuclear power plants have experienced forced outstages because flaws were missed in the manual analysis of eddy current data. This has motivated the need for an automated signal processing technique that can provide increased detection reliability while streamlining the analysis. This research program focuses on optimizing the detection algorithms. Future work will concentrate on classifying the signals deemed relevant. A comparsion of various signal detection schemes has been carried out with the emphasis on conservatively calling flaws without excessive overcalling. Favorable results have been achieved using instantaneous derivatives of amplitude and phase for signal features and distinguishing flaws from non-flaws using the Fisher Linear Discriminant method.

36213 **(EPRI-NP—5812) Modeling Babcock and Wilcox steam generators during auxiliary feedwater injection: Final report.** Wallis, G.B.; Soliman, H.M.; Kuo, J.T. (Electric Power Research Inst., Palo Alto, CA (USA); Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Apr 1988. 98p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010997/JAW.

The performance of B&W once-through steam generators during elevated feedwater injection is governed by several fluid flow and heat transfer phenomena. Among the most significant of these phenomena are the primary flow distribution, flooding at the tube support plates, water distribution in the injection region and redistribution at the tube support plates, and heat transfer in the wetted region. All these phenomena were analyzed, either by applying the results of earlier investigations, or by developing new models when the specific situation of interest was not studied before. Results of the present analyses compared reasonably well in magnitude and trend with the experimental results of GERDA and SAIC tests. Based on these successful comparisons it is concluded that the present analytical models describe the fluid mechanics and heat transfer phenomena sufficiently well for use in the prediction and interpretation of experimental results in the MIST program.

36214 **(EPRI-NP—5865) Feature-enhanced-imaging field trials: Peach Bottom Unit 3.** Selby, G.; Williams, R.; Shankar, R. (Electric Power Research Inst., Palo Alto, CA (USA); Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). Jun 1988. 97p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011772/JAW.

Feature-based systems that combine imaging and signal analysis capabilities may be useful for nondestructive evaluation (NDE) of plant components. This report describes the field evaluation of an integrated system at a plant site during a scheduled outage for pipe weld examination to discriminate intergranular stress corrosion cracking (IGSCC) from benign, geometrical reflectors. The integrated system consisted of a personal computer (PC)-based system capable of detailed analysis of ultrasonic signal data and an in-service inspection (ISI) imaging system used in many commercial pipe examinations for IGSCC. The integrated system was trained to discriminate automatically IGSCC from other reflectors using EPRI NDE Center's inventory of field-removed samples. The methods and results of this training are described. Several classifiers were synthesized using mathematical features derived from signals that were collected to simulate field conditions. Data collection procedures were developed that require minimal operator training. Field data were collected and anlayzed before pipe decontamination prior to pipe replacement. Automatic decision maps were generated for easier data interpretation. The field trial was conducted in October-November 1987. Future activities (January-March 1988) will include collecting additional data after pipe decontamination and after pipe removal to compare changes in baseline. These results will be presented in subsequent reports.

36215 **(EUR—11023) Behaviour of the nozzle corner region during the first phase of the fatigue test on scaled models of pressure vessels (JRC Vessel A).** Jovanovic, A.; Lucia, A.C.; Brunnhuber, R.; Elbaz, J.M.; Schwarz, U. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1987. 98p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753949/JAW.

The work presented here deals mainly with the stress and fracture mechanics aspects of the first phase of the structural reliability experimental program based on the scaled experimental vessel at Ispra. The overall research and experiments make also part of the structural reliability assessment extrapolation pattern for the full-scale structures. The work presented here deals with the problem of the nozzle corner cracks induced by the fatigue under the pressure cycling.

36216 **(EUR—11054) CCF-RBE common cause failure reliability benchmark exercise.** Poucet, A.; Amendola, A.; Cacciabue, P.C. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1987. 129p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753950/JAW.

This report summarizes results, obtained by the participants in the Reliability Benchmark Exercise on Common Cause Failures (CCF-RBE). The reference power plant of the CCF-RBE was the NPP at Grohnde (KWG): it is a 1300 MW PWR plant of KWU design and operated by the utility Preussen Elektra. The systems studied were the Start-up and Shut-down system (RR/RL) and the

Emergency Feedwater System (RS) both systems that can feed water into the steam generators in the emergency power mode. The CCF-RBE was organized in two phases: 1. The first phase: during which all participants have performed an analysis on the complete system as defined by the assumed boundaries, i.e. the Start-up and Shut-down system (RR/RL) and the Emergency Feedwater System (RS). 2. The second phase: in which the scope was limited to the RS system. This limitation in scope was agreed upon in the discussion on the results of the first phase, which showed that, within the boundaries of the exercise, RR/RL and RS systems could be considered independent of each other. This report gives an overview of the works carried out, the results obtained and the conclusions and lessons that could be drawn from the CCF-RBE.

36217 **(FRNC-TH—3231) Study of thermal - hydraulic sensors signal fluctuations in PWR.** Hennion, F. (Grenoble-1 Univ., 38 (France); Institut National Polytechnique, 38 - Grenoble (France)). Oct 1987. 207p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753967/JAW.

This thesis deals with signal fluctuations of thermal-hydraulic sensors in the main coolant primary of a pressurized water reactor. The aim of this work is to give a first response about the potentiality of use of these noise signals for the functionning monitoring. Two aspects have been studied: - the modelisation of temperature fluctuations of core thermocouples, by a Monte-Carlo method, gives the main characteristics of these signals and their domain of application. - the determination of eigenfrequency in the primary by an acoustic representation could permit the monitoring of local and global thermo-hydraulic conditions.

36218 **(INIS-BR—968) Fatigue of welded joint in a stainless steel AISI 304 L.** Kuromoto, N.K.; Guimaraes, A.S.; Miranda, P.E.V. de; Pascual, R. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1986. 16p. (In Portuguese). (CONF-8610317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701622/JAW.

From 4. Brazilian symposium on piping and pressure vessels; Salvador, BA, Brazil (28 Oct 1986).

The flexion fatigue behavior for the base metal and welded joint of an AISI 304 L stainless steel type, used in the Angra-1 reactor, was determined. An automatic welding process was used with improved procedures in order to assure better welding metallurgy. Fatigue tests samples reinforcements were done to allow the evaluation of metallurgical variables, specially the role played by delta ferrite. The resulting welded joint showed better fatigue life than the base metal. Delta ferrite was found to play an important role on the initiation and propagation processes of the fatigue cracks.

36219 (INIS-mf—11153, pp 24-29) **2. Nuclear safety of nuclear power plants.** Kriz, Z. 1987. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780081/JAW.

In Nuclear power. CAEC lecturers' manual.

Nuclear safety is defined in Czechoslovak regulations as the condition and capability of nuclear installations and their operators of preventing uncontrolled development of fission chain reaction and release of radioactive material and of ionizing radiation in the environment. From this point of view, two basic principles are described of securing nuclear safety in the installation project design, namely, the so-called in-depth protection comprising the prevention, control and localization of failures and accidents, and a system of subsequent physical barriers against radioactive material propagation. The role of siting, securing the quality of installations, and of operating personnel of nuclear power plants is briefly characterized with respect to nuclear safety. State inspection bodies whose task and operations are briefly described are the guarantors of the observance of the safety requirements. (Z.M.).

36220 **(INIS-mf—11230) Nuclear power constructions. Feasibility study and project design in the process of nuclear power plant construction.** Chalus, Z.; Kripner, V.; Petrak, P.; Cihlar, M.; Riha, S. (Ceskoslovenska Komise pro Atomovou Energii, Prague; Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program; ORGREZ, Prague (Czechoslovakia); Vyzkumny Ustav Pozemnich Staveb, Prague (Czechoslovakia); Kovoprojekta, Prague (Czechoslovakia)). (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1987. 234p. (In Czech). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702878/JAW.

The feasibility study and the project design and their role in the process of nuclear power plant construction are analyzed in detail. From the point of view of systems aspects of scientific management, the nuclear power plant is considered to be an element of the power generation and transmission system as well as an intersection of capital investment, scientific and technical development and project designing. Foreign experience is summed up with the planning, designing and building of nuclear power plants. Attention is centred to the feasibility study and project design stages of nuclear power plant construction in the CSSR. The questions are discussed of capital investment, territorial planning activities, preproject and project documentation; a survey is presented of legislative provisions involving the project design and capital investment spheres. Briefly outlined are topics for further rationalization of feasibility studies, such as standardization and complex project designs of WWER type nuclear power plants, the introduction of data processing in capital investment provision of WWER type nuclear power plants, and international scientific and technical cooperation including the establishment of a international consultancy centre for the designing and methodology of controlling the building, repairs, reconstruction and the decommissioning of WWER type nuclear power plants. (Z.M.). 81 figs., 2 tabs., 12 refs.

36221 (IWGATWR—1-2, pp 7-9) **Preliminary considerations of APWR development in China.** Shen, W. (Ministry of Nuclear Industry, Beijing (China)). Dec 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

36222 (IWGATWR—1-2, pp 22-23) **Summary of the Federal German presentation on advanced light water reactors.** Meyer, P.J. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Dec 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

36223 (IWGATWR—1-2, pp 33-38) **Trends in the development and safety improvement of WWER reactors.** Biryukov, G.I.; Vikhorev, Yu.V.; Denisov, V.P.; Ermakov, N.I.; Lunin, G.L.; Smirnov, A.M.; Stekol'nikov, V.V.; Fedorov, V.G. (Opytnoe Konstruktorskoe Byuro, Moscow (USSR)). Dec 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

36224 (IWGATWR—1-2, pp 41-43) **Overview of programs in the USA on development of advanced light water reactor designs and technology.** Lang, P. (USDOE, Washington, DC). Dec 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

36225 (NUREG/CR—5013) Fatigue life characterization of smooth and notched piping steel specimens in 288{degree}C air environments. Terrell, J.B. (Materials Engineering Associates, Inc., Lanham, MD (USA)). May 1988. 64p. (MEA—2232). NTIS, PC A05/MF A01 - GPO;1. Order Number TI88010175/JAW.

Fatigue strain-life tests were conducted on ASME SA 106-B piping steel at 24{degree}C (76{degree}F) and at PWR operating temperature, 288{degree}C (550{degree}F), under completely reversed loading. Smooth specimens were tested at both temperatures whereas specimens containing notches of various acuities were tested at 288{degree}C. Fatigue limits at 10^7 cycles were estimated to be 185 MPa (26.8 ksi) at 24{degree}C and 232 MPa (33.7 ksi) at 288{degree}C. The difference in fatigue strength observed at the PWR temperature is postulated to be due to dynamic strain aging processes. However, there is a reduction in low cycle fatigue strength at this temperature which results in a decrease in the intended safety factor of the ASME Section III design curve for carbon steels. Notch strain histories were estimated for the notched specimen tests using various interpretations of Neuber's rule. It was concluded that the use of the fatigue notch concentration factor (K/sub f/) in the Neuber relation in conjunction with the uniaxial cyclic stress-strain curve provided the best correlation of notched specimen fatigue data with results obtained from smooth specimen tests. The notched specimen strain-life results derived from the application of Neuber's rule alone proved to be conservative when compared to smooth specimen test results to such an extent that Neuber-generated notch stress and strain amplitudes cannot be compared to the ASME Section III fatigue curves for carbon steels.

36226 (NUREG/CR—5020) A summary of environmentally assisted crack-growth studies performed at Westinghouse Electric Corporation: Under funding from the Heavy-Section Steel Technology Program. Bamford, W.H. (Westinghouse Electric Corp., Pittsburgh (USA). Generation Technology Systems Div.). May 1988. Contract AC05-84OR21400. 245p. (ORNL/Sub—82-21598/1). NTIS, PC A12/MF A01 - GPO;1. Order Number TI88010793/JAW.

This report was prepared as an attempt to collect the information developed in the crack-growth studies at Westinghouse from 1969 to 1986. Although progress reports were issued regularly over the entire period, the program results have not previously been integrated in a single document. The effect of a pressurized-water environment in the enhancement of fatigue crack growth at low frequencies of loading was discovered by Kondo in 1971 and verified in this program shortly thereafter. To characterize plates and forgings, as well as welds and heat-affected zones, a very large number of tests were done in the program. These tests were carried out in a series of matrices structured to investigate various issues, and the results are collected in this report. This work provided a data base for development of ASME Code reference crack-growth curves, as well as insights into some of the mechanisms of environmental enhancement. Static-load crack-growth-rate tests were conducted in the program with some specimens loaded in excess of 11 years. Static-load crack growth was observed in the heat-affected zone specimens and in one base metal heat after several years of exposure.

36227 (SCSIN-REP—5-1-B-82) Meteorological instrumentation. (Ministere de l'Industrie et de la Recherche, 75 - Paris (France). Service Central de Surete des Installations Nucleaires). Jun 1982. 12p. (SIN—E-2745-82). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752580/JAW.

RFS or "Regles Fondamentales de Surete" (Basic Safety Rules) applicable to certain types of nuclear facilities lay down requirements with which compliance, for the type of facilities and within the scope of application covered by the RFS, is considered to be equivalent to compliance with technical French regulatory practice. The object of the RFS is to take advantage of standardization in the field of safety , while allowing for technical progress in that field. They are designed to enable the operating utility and contractors to know the rules pertaining to various subjects which are considered to be acceptable by the "Service Central de Surete des Installations Nucleaires" or the SCSIN (Central Department for the Safety of Nuclear Facilities). These RFS should make safety analysis easier and lead to better understanding between experts and individuals concerned with the problems of nuclear safety. The SCSIN reserves the right to modify, when considered necessary any RFS and specify, if need be, the terms under which a modification is deemed retroactive. The purpose of this RFS is to specify the meteorological instrumentation required at the site of each nuclear power plant equipped with at least one pressurized water reactor.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 36292, 36293, 36294, 36371, 36395, 36397, 36402, 36440, 36844, 39006

36228 (CONF-880506—13) The passive safety characteristics of modular high temperature gas-cooled reactor fuel elements. Goodin, D.T.; Kania, M.J.; Nabielek, H.; Schenk, W.; Verfondern, K. (General Atomics Co., San Diego, CA (USA); Oak Ridge National Lab., TN (USA); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010132/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

High-Temperature Gas-Cooled Reactors (HTGR) in both the US and West Germany use an all-ceramic, coated fuel particle to retain fission products. Data from irradiation, postirradiation examinations and postirradiation heating experiments are used to study the performance capabilities of the fuel particles. The experimental results from fission product release tests with HTGR fuel are discussed. These data are used for development of predictive fuel performance models for purposes of design, licensing, and risk analyses. During off normal events, where temperatures may reach up to 1600{degree}C, the data show that no significant radionuclide releases from the fuel will occur.

36229 (CONF-880702—9) Status of international HTGR [high-temperature gas-cooled reactor] development. Homan, F.J.; Simon, W.A. (Oak Ridge National Lab., TN (USA); General Atomics Co., San Diego, CA (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010447/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Programs for the development of high-temperature gas-cooled reactor (HTGR) technology over the past 30 years in eight countries are briefly described. These programs have included both government sector and industrial participation. The programs have produced four electricity-producing prototype/demonstration reactors, two in the United States, and two in the Federal Republic of Germany. Key design parameters for these reactors are compared with the design parameters planned for follow-on commercial-scale HTGRs. The development of HTGR technology has been enhanced by numerous cooperative agreements over the years, involving both government-sponsored national laboratories and industrial participants. Current bilateral cooperative agreements are described. A relatively new component in the HTGR international cooperation is that of multinational industrial alliances focused on supplying commercial-scale HTGR power plants. Current industrial cooperative agreements are briefly discussed.

36230 (CONF-880702—10) MHTGR [Modular High-Temperature Gas-Cooled Reactor] technology development plan. Homan, F.J.; Neylan, A.J. (Oak Ridge National Lab., TN (USA); General Atomics Co., San Diego, CA (USA)). 1988. Contract AC05-84OR21400. 6p. (CONF-880702—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010445/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

This paper presents the approach used to define the technology program needed to support design and licensing of a Modular High-Temperature Gas-Cooled Reactor (MHTGR). The MHTGR

design depends heavily on data and information developed during the past 25 years to support large HTGR (LHTGR) designs. The technology program focuses on MHTGR-specific operating and accident conditions, and on validation of models and assumptions developed using LHTGR data. The technology program is briefly outlined, and a schedule is presented for completion of technology work which is consistent with completion of a Final Safety Summary Analysis Report (FSSAR) by 1992.

36231 **(IAEA-TECDOC—436) Gas-cooled reactors and their applications. Proceedings of a technical committee meeting held in Juelich, 20-23 October 1986.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1987. 547p. (CONF-8610160—). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW.

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The purpose of the meeting was to review and discuss the current status and recent progress made in the technology and design of gas-cooled reactors and their application for electricity generation, process steam and process heat production. The meeting was attended by more than 200 participants from 25 countries and International Organizations presenting 34 papers. The technical part of the meeting was subdivided into 7 sessions: A. Overview of the Status of Gas-Cooled Reactors and Their Prospects (2 papers); B. Experience with Gas-Cooled Reactors (5 papers); C. Description of Current GCR Plant Designs (10 papers); D. Safety Aspects (4 papers); E. Gas-Cooled Reactor Applications (3 papers); F. Gas-Cooled Reactor Technology (6 papers); G. User's Perspectives on Gas-Cooled Reactors (4 papers). At the end of the meeting a round table discussion was organized in order to summarize the meeting and to make recommendations for future activities. A separate abstract was prepared for each of the 34 presentations of this meeting. Refs, figs and tabs.

36232 (IAEA-TECDOC—436, pp 11-27) **Magnox reactors and advanced gas-cooled reactors.** Pexton, A.F. (South of Scotland Electricity Board, Glasgow (UK)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

Commercial nuclear power in the U.K. is based on CO_2 cooled graphite moderated reactors. The first seven stations have steel pressure vessels with external boilers connected by gas ducts. The last two have an integrated design with core, boilers and gas circulators enclosed in pre-stressed concrete pressure vessels. The magnox reactors have given good service and the older stations are now being subjected to careful review after 20 years operation. Magnox was superseded by the AGR and five twin reactor stations to three separate and distinct designs, but all with integral gas circuits inside concrete pressure vessels, were ordered in the period 1965 to 1970. The most successful of these, at Hinkley Point 'B' and Hunterston 'B' have now been in operation for over 10 years. Their load factor for the past few years has been of the order of 80%. In 1979 two further twin reactor AGR stations, Heysham II and Tornes, were authorised. These were based on the HinkleyHunterston design with detailed improvements arising from operating experience and developments in safety standards. Commissioning tests are now well advanced and the first reactors at each station are scheduled to come into operation in 1987. Work has proceeded close to the original programme and budget. The Heysham IITorness design now provides a standard base for on-going development of the AGR. A study is in hand which essentially replicates the main features, but by effective use of margins enables higher output to be achieved. The future depends on government policy following issue of the report of the inquiry into CEGB's application to build a PWR at Sizewell, as well as on the political environment following Chernobyl. Whatever the outcome, however, the AGR provides an attractive option with many inherently favourable safety characteristics. Whilst it is difficult to see an incentive for the U.K. to change to an alternative form of gas-cooled reactor technology, U.K. (Abstract Truncated)

36233 (IAEA-TECDOC—436, pp 29-39) **High temperature gas-cooled reactors.** Schulten, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The historical development in energy technology has the goal of realizing high temperatures and high efficiencies for the energy conversion processes. The high temperature reactor (HTR) realizes this goal in the best way compared to other reactor types; it uses ceramic materials and helium as the heat transfer media. The development of the fuel elements on the basis of coated particles is considered to be finished. Future applications are the production of electricity and the production of process heat for other areas of the energy market. Originally the thorium/uranium fuel cycle has been envisaged, today the low enriched uranium fuel cycle is of interest, because of the low prices of uranium. Typical for the HTR is its flexibility with respect to different concepts. On the basis of the existing prototypes AVR, THTR-300 and Forth St. Vrain the following two development lines are in discussion: reactors of small unit size and reactors of medium unit size. The safety qualities have been demonstrated by the operation of the AVR reactor in Juelich, which is now in operation for 19 years. These experiences will be of great importance for future plants. (author). 7 figs.

36234 (IAEA-TECDOC—436, pp 43-51) **Development of a high output AGR.** Keen, B.A. (National Nuclear Corp. Ltd., Knutsford (UK)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper outlines the design of a new AGR based on the Heysham II/Torness reactors which are nearing completion of their construction stage. The intent is to replicate as far as possible the Heysham II/Torness design in meeting the target station generator output of 1526 MW(e), and this can be achieved by design changes only to the HP steam pipework. Two additional design options, a vented containment and a dry refuelling route, are also under consideration. (author). 1 fig., 1 tab.

36235 (IAEA-TECDOC—436, pp 53-59) **Technical evolution and operation of French CO_2 cooled reactors (UNGG).** Berthion, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The technical evolution of the five French CO_2 cooled reactors (UNGG) from 1981 to 1986 needs to be outlined. These technical evolutions concerned the fuel element of Bugey 1 which is now slightly enriched, as well as the load reduction operation required by the grid. In addition work is underway to increase the safety at the two St Laurent units, or to repair the hot steel upper-structures of Chinon-3 unit. (author). 4 figs, 4 tabs.

36236 (IAEA-TECDOC—436, pp 61-69) **Fort St. Vrain performance.** Brey, H.L. (Public Service Co. of Colorado, Denver (USA)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

Fort St. Vrain, on the system of Public Service Company of Colorado, is the only high temperature gas-cooled power reactor in the United States. This plant was designed by General Atomic Company and utilizes helium as the primary coolant. The core consists of triso-coated uranium and thorium fuel particles cast into cylinical rods within prismatic graphite blocks. The primary coolant system consists of the reactor, twelve steam generator modules, and four helium circulators contained within a prestressed concrete reactor vessel. The once-through steam generators provide high quality 1,000 deg. F, 2,400 psi main steam and 1,000 deg. F reheat

steam to the main turbine. The plant has generated 3,334,000 MWH of electricity and has undergone 3 reactor refuelings. Many of the primary system components at Fort St. Vrain are proto-typical in nature and this plant has undergone an extensive and elaborate testing program. Difficulties primarily with the helium circulators and fuel element column movements particularly at high power levels have resulted in significant modifications. Power operation at 100% was achieved in late 1981 with a net thermal efficiency of nearly 39%. Excellent performance of the coated fuel particles has contributed to a full power circulating activity sixty times lower than the design with subsequent cleanliness throughout the plant. Except for 1985, when a combined total radiological exposure for all personnel reached 35 manrem due to the necessity to completely refurbish all of the control rod drive mechanisms, the average total combined exposure for each of the past five years was under 3 manrem. This exemplary radiological cleanliness has, with the exception of tritium, allowed Fort St. Vrain to consistently operate with noble gas airborne and liquid effluent releases more than an order of magnitude lower than the average for the U.S. nuclear power industry. (author). 7 refs, 5 figs.

36237 (IAEA-TECDOC—436, pp 71-97) **AVR experience.** Ziermann, E. (Arbeitsgemeinschaft Versuchs-Reaktor G.m.b.H., Juelich (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper contains a description of the Arbeitsgemeinschaft Versuchsreaktor (AVR), a small pebble bed HTGR located in Juelich, Federal Republic of Germany. Besides a description of plant design, the experience made with main components, the operating performance and operational results are presented together with an outlook to possible future plant improvements. (author). 23 figs.

36238 (IAEA-TECDOC—436, pp 99-108) **THTR operation: The first year.** Schwarz, D. (Vereinigte Elektrizitaetswerke Westfalen A.G. (VEW), Dortmund (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper contains a description of the performance of the THTR-300 since its first criticality in 1985. The THTR-300 is a pebble bed HTGR of 300 MW(e) located in Schmehausen/Uentrop in the Federal Republic of Germany. The main steps and events during the start-up and commissioning phase are presented and discussed in detail. (author). 3 figs, 1 tab.

36239 (IAEA-TECDOC—436, pp 111-121) **Restoration of a CEGB Magnox reactor to full power.** Paynter, R.J.; Roberts, B.J.; Sawbridge, P.T. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The Hinkley Point 'A' Magnox Reactor was commissioned in 1965 and recently completed its 21 calendar year of operation. The paper contains a description of the operating experience of this plant together with the main technical problems and their solutions. (author). 10 figs, 1 tab.

36240 (IAEA-TECDOC—436, pp 123-133) **Modular high-temperature gas-cooled reactor (MHTGR).** Neylan, A.J. (GA Technologies, Inc., San Diego, CA (USA)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The MHTGR is an advanced reactor concept being developed in the USA under a cooperative program involving the US Government, the nuclear industry and the utilities. The design utilizes basic HTGR features of ceramic fuel, helium coolant and a graphite moderator. However the specific size and configuration is selected to utilize the inherently safe characteristics associated with these standard features coupled with passive safety systems to provide a significantly higher margin of safety and investment protection than current generation reactors. Evacuation or sheltering of the public is not required. The major components of the nuclear steam supply, with special emphasis on the core, are described. Safety assessments of the concept are discussed.

36241 (IAEA-TECDOC—436, pp 135-139) **Status of gas-cooled reactor development in the USSR.** Grebennik, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper contains a description of HTGR concepts as being developed in the USSR for electricity generation and process steam and heat production. The HTGR-M, a module type reactor, and the VG-400 are presented together with their main design features and their applications. (author). 3 refs.

36242 (IAEA-TECDOC—436, pp 141-150) **Nuclear electricity and heat generation using the VG-400 reactor.** Bulygin, V.V.; Vorontsov, V.E.; Grebennik, V.N.; Ionov, E.M.; Protsenko, A.N.; Stolyarevskij, A.Ya.; Shishkin, S.V.; Panov, Yu.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper contains a description of HTGR concepts as being developed in the USSR for electricity generation and process steam and heat production. The HTGR-M, a module type reactor, and the VG-400 are presented together with their main design features and their applications. (author). 5 refs, 6 figs, 1 tab.

36243 (IAEA-TECDOC—436, pp 151-164) **Current status of research and development of HTGR in Japan.** Hayashi, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

In Japan, the very high-temperature reactor (VHTR) for a nuclear process heat application has been developed by Japan Atomic Energy Research Institute (JAERI) since 1969. Looking back upon the activities, there are considerably accumulated technologies enough to construct the experimental VHTR. Recently, however, economic structure in Japan has been changed with the low growth rate of economy and the nation's energy demands have been relieved so rapidly that the needs for nuclear process heat application have been declined. This trend also has been accelerated by introducing firmly the energy-saving technologies in industry and with increasing of the electric power generation by light water reactors. In this situation, the Special Committee of Japan Atomic Energy Commission (JAEC) has recognized newly the significance of the VHTR development from the viewpoint of long future and has recommended the construction of a high-temperature engineering test reactor (HTTR) to upgrade the current VHTR technologies. JAERI has started new deployment of the HTTR as a research facility to prepare for the realization of nuclear process heat application in the 21st century. This paper deals with technical background and the current design concept of the HTTR. (author). 3 figs, 3 tabs.

36244 (IAEA-TECDOC—436, pp 165-177) **Plant design of a high temperature engineering test reactor in JAERI.** Baba, O. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The Special Committee on HTGR Research and Development Program submitted an interim report after serious discussion

which recommended that a high temperature engineering test reactor (HTTR in this report) should be built to make possible irradiation tests not only for HTGR fuel but also for various materials in high temperature. The required functions to HTTR and its basic design condition are described together with selecting progress. A preliminary design of a high temperature testing reactor, which makes possible HTGR fuel irradiation tests and demonstration tests of HTGR inherent safety, has been done and the results are also explained. (author). 1 ref., 7 figs, 2 tabs.

36245 (IAEA-TECDOC—436, pp 179-197) **Status of the HTR-Module plant design.** Weisbrodt, I.A.; Steinwarz, W.; Klein, W. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

Based on the demand for a technically clear, safe and economic reactor system, the KWU Group consistently used the extensive know-how obtained from German light water reactor technology and successful operation of the AVR for development of the HTR-Module. With its operating and safety features and its flexible application possibilities, this reactor concept fulfills current market demands to a substantial extent. (author). 10 figs.

36246 (IAEA-TECDOC—436, pp 199-212) **Small nuclear power plants: 10 MW GHR gas-cooled heating reactor.** Schmitt, H. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The GHR is a simple, safe and economic heating reactor that is designed on the basis of the proven technology of the Gas-Cooled High-Temperature Reactor. The main benefits derive directly from the favourable technical and safety related HTR-characteristics. These are: low radiation exposure; high inherent safety, even in the event of hypothetical accidents; few active systems. The HRB/BBC-design of the GHR makes a wide use of developed and proven HTR components, such as: proven fuel elements containing coated particles for an extremely favourable fission product retention; helium as a coolant and ceramic structures that insure stability of the structures under all conditions; components manufactured for AVR and THTR and tested up to service life loads. The reactor pressure vessel, the intermediate circuit, the control room and all safety related systems are located underground which provides protection against all external impacts, sabotage etc. The remaining overground building is of small, conventional design and only houses auxiliary systems. The whole nuclear heat generating system (primary system) is integrated into a prestressed concrete reactor pressure vessel. It is composed of the core, the absorber rods, a circulator and a heat exchanger to transfer the heat via the intermediate circuit to the consumer circuit. The reactor control philosophy, the decay heat removal systems and the fission product retention barriers follow HTR-principles, which as a whole characterizes the GHR heating plant by the following features: simply operating; passive safety; less maintenance and operating effort; very low radiation exposure; fuel elements for long operating periods; low energy generating costs; shop prefabrication; short construction period. (author). 8 figs.

36247 (IAEA-TECDOC—436, pp 235-250) **HTR 500: The basic design for commercial HTR power stations.** Baust, E.; Schoening, J. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

With the completion of the THTR 300 and the development of the THTR follow-on plant HTR 500, BBC/HRB have taken the pebble bed high-temperature reactor to the threshold of commercialization. The THTR 300 is the reference plant for the entire high-temperature reactor line in the power range between 100 and 600 MW. In addition, the experience is available which has been acquired with the successful 19 years operation of the 15 MW AVR in Juelich, also constructed by BBC/HRB. As a next step of market penetration in the Federal Republic of Germany the construction of the HTR 500 is intended, a power station for electricity generation and the possibility to extract process heat and district heat. The power size of 550 MW takes account of the modified demand on the nuclear power plant market which for reasons of grid size, financing expenses and the lower increase in electricity demand internationally shows a trend towards smaller power units in the range between 400-600 MW. For special applications in industry (cogeneration of steam and electric power) and for special siting conditions (near industrial centers) the small 100 MW HTR has been developed which can also be constructed as a 200 MW twin-plant under economic conditions, competitive with conventional power plants of the same size without involving the problem of air pollution. After the Chernobyl reactor disaster the high inherent safety of the HTR has been under discussion with increased emphasis. In the present situation characterized by sensitive attitude toward nuclear energy, the HTR with its high safety potential offers favourable conditions regarding its acceptance by the public and politicians. The HTR is a decisive innovation in the field of reactor technology which represents an important contribution to the intermediate and long-term supply of safe, environmental and economic energy to the entire electricity and heat market. (Abstract Truncated)

36248 (IAEA-TECDOC—436, pp 253-265) **Safety characteristics of current HTR.** Kroeger, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper contains a description of HTR-safety features and results of safety calculations for the HTR-500, a 550 MW(e) pebble bed HTGR. A set of advanced safety criteria is proposed and discussed. (author). 4 refs, 5 figs, 4 tabs.

36249 (IAEA-TECDOC—436, pp 267-282) **Safety concept of the modular HTR.** Lohnert, G.H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper contains the most important design features of the modular HTGR with pebble bed fuel and a description of modular HTGR safety features and safety concepts. Components of the nuclear steam supply system are described together with their impact on the plant's safety behaviour. (author). 4 figs, 1 tab.

36250 (IAEA-TECDOC—436, pp 283-294) **MHTGR licensing approach and plant response to off normal events.** Neylan, A.J.; Silady, F.A. (GA Technologies, Inc., San Diego, CA (USA)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The MHTGR design meets stringent top-level regulatory and user safety requirements that require that the normal and off-normal operation of the plant not disturb the public's day-to-day activities. Quantitative, generic top-level regulatory criteria have been specified from US NRC and EPA sources to guide the design. The user has further specified that these be met at the plant boundary. A probabilistic risk assessment has been utilized to select licensing basis events that cover a wide spectrum of events. The events have been grouped into three frequency regimes governed by the 10CFR50 App. I, 10CFR100, and PAG risk and dose criteria. The MHTGR fuel has been designed to limit the primary circuit activities to levels that, even if completely released, are within those allowed by 10CFR100. The focus of the safety approach has then been centered on retaining the radionuclide inventory within the

fuel by removing core heat, controlling chemical attack, and by controlling heat generation. The core geometry, core power, core power density, heat removal geometry, and heat sinks are designed to provide passive core temperatures during accidents. To limit the potential for chemical attack of the MHTGR core, the primary coolant boundary is designed to make large ingress of air and water very unlikely. Furthermore, the fuel particle coatings are highly impervious to oxidizing agents that do enter the primary coolant. The core heat generation is controlled by the large negative temperature coefficient and by insertion of control material to maintain a subcritical core configuration during the span of the accidents. Thus, the three key safety functions have been accomplished by relying on the inherent characteristics of the MHTGR so that the response is largely passive and relatively simple. (author). 4 refs, 5 figs, 1 tab.

36251 (IAEA-TECDOC—436, pp 295-310) **Comparison of regulatory aspects in different countries.** Hofmann, K. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

High Temperature Gas Cooled Reactors (HTGR) for the generation of electricity are at present only operated in the United States of America (USA) and the Federal Republic of Germany (FRG). Major development work is also evident in the High Temperature Reactor sector in these countries. Aspects of licensing practice in the USA and the FRG are therefore dealt with to give you possible impetus for the procedure to be adopted in countries where the HTGR technology will be introduced. The design criteria and the technical codes must be supplemented with regard to the requirements of High Temperature Gas Cooled Reactors. Moves in this direction and experience in the application of the relevant codes to High Temperature Gas Cooled Reactors, codes which are mostly oriented to Light Water Reactors (LWR), are to be found in the USA and the FRG in conduct of HTGR licensing procedures. Some criteria have to be applied in an analogous manner. The analogous application of criteria for HTGRs depends on the HTGR-design and refers mainly to the criterion for testability with respect to periodic inspections and tests, the criteria for shutdown systems, residual heat removal systems, reactor coolant boundary and the reactor containment. The IAEA standard "Design for Safety of Nuclear Power Plants, A Code of Practice" is applicable to HTGRs without major difficulties. (author). 11 refs, 1 fig.

36252 (IAEA-TECDOC—436, pp 313-328) **HTGR applications, prospectives and future development.** Barnert, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The high temperature reactor (HTR) is an advanced reactor concept: it is "unrestrictedly safe against catastrophes", can be used for electricity production and process heat applications and is economically attractive. It offers a broad variety of possible applications in the future energy market. The next step in the development is the systems demonstration, e.g. with AVR-extension. (author). 10 refs, 14 figs.

36253 (IAEA-TECDOC—436, pp 329-341) **Perspectives of HTGRs in chemical and iron and steel industries of Japan.** Tsuruoka, K.; Katamine, T.; Miyasugi, T.; Araki, R. (Kawasaki Steel Technical Research Corp., Tokyo (Japan); Sumitomo Chemical Company Ltd, Tokyo (Japan); Chiyoda Chemical Engineering and Construction Company Ltd, Yokohama (Japan)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

A High Temperature Gas-Cooled Reactor (HTGR) can solve the problems in improving the economy and broadening the field of utilizing nuclear energy while maintaining safety, due to its specific characteristics of high temperature heat, inherent safety, and high burn-up. Considering the importance to use nuclear energy in non-electric fields in the future, this paper presents a recent study on the perspective of the HTGR in the chemical and iron and steel industries of Japan, conducted by the Japan Atomic Industrial Forum. Although the heat generated by the HTGR will be expensive for use by the chemical and iron and steel industries in the rest of the 20th century, the chemical industry has many good processes which can apply nuclear heat when the cost is competitive compared with fossile fuels. Among them, the process for hydrogen production could be considered for major application. The iron and steel industry has a big potential for use of reducing gas produced by nuclear heat with sufficiently competitive cost. (author). 6 refs, 1 fig., 4 tabs.

36254 (IAEA-TECDOC—436, pp 343-368) **Israeli perspective on HTGRs.** Barak, A.; Beck, A.; Greenspan, E.; Szabo, J.; Blumenau, L.; Branover, H.; El-Boher, A.; Spero, E.; Sukoriansky, S. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

A preliminary assessment of the interest Israel should have in the HTGR technology, and of possibilities for improving the efficiency of HTGRs using the Liquid Metal MHD (LMMHD) energy conversion technology is undertaken. Modular HTGRs were found to offer a collection of features which make them attractive in the Israeli conditions. These features include inherent safety, resistance against acts of war, investment protection, suitability to the Israeli seismic conditions and to dry cooling, possibility for optimal development of the Israeli grid and, hopefully, for economical sea-water desalination and oil-shale utilization. Being free of rotating machinery and being applicable over the entire temperature range of HTGR energy delivery, the LMMHD technology opens new promising possibilities for utilizing the high temperature operation - ability of HTGRs for the production of electricity. A number of novel LMMHD cycles were conceived and attractive matches to the unique HTGR heat source characteristics were identified; they enable producing electricity with efficiencies which exceed 70% of the ideal efficiencies even in the very high temperature domain. For example, the LMMHD technology might enable attaining net efficiencies of 43% and 47% in, respectively, the first and second generation of HTGRs as compared with efficiencies of 37% to 40% attainable with conventional steam energy conversion technology. (author). 17 refs, 5 figs, 2 tabs.

36255 (IAEA-TECDOC—436, pp 371-385) **Overview of US MHTGR base technology development program.** Jones, J.E. Jr.; Kasten, P.R. (Oak Ridge National Lab., TN (USA)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The Base Technology Development Program for the Modular High Temperature Gas Cooled Reactor (MHTGR) provides basic information on fuel performance, fission product retention capabilities, and material properties; the program plan for obtaining such information is summarized, considering the specific needs of the MHTGR concept. Continued international cooperation in HTGR base technology development will contribute to the planned program. (author). 13 figs.

36256 (IAEA-TECDOC—436, pp 387-405) **Status and development of the German materials programme for the HTGR.** Nickel, H.; Schubert, F.; Schuster, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

During the last decade the research and development of materials for the HTGR in Germany have mainly been directed to-

wards the qualification of high temperature structural alloys for heat transferring components of advanced nuclear process heat plants. The availability of Fe/Ni-base and Ni-base alloys for long term service loading has in principle been established. Furthermore, materials and optimization have indicated that improvements in the corrosion properties are also achievable. The status of the material evaluation and optimization are demonstrated with NiCr 22 Co 12 Mo (Alloy 617) and Thermon 4972 for heat exchanging components, with the steel DIN Werkstoff-Nr. 1.4981 (X 8 CrNiMoNb 16 16) for absorber and control rods and carbon fibre reinforced carbon (CFC) for hot ducting. The continuing HTR structural materials programme is aimed at improving the quality and data base of the materials for components of advanced HTGR's, both for nuclear heat application and for the steam cycle. Emphasis is given: to the determination of long term design values for different semi-finished products including weldments; to improve service life estimation rules; to improve constitutive equations for inelastic analysis and to develop design rules; to develop fracture mechanics criteria for leak - before - break argumentations. The general aim of this work is to assure the long term integrity of class I components. Using typical examples, this paper shows the status of the theoretical and experimental work related to these objectives. (author). 25 refs, 16 figs.

36257 (IAEA-TECDOC—436, pp 407-428) **KVK and status of the high temperature component development.** Jansing, W.; Breitling, H.; Candeli, R.; Teubner, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The High Temperature Helium Test Facility which started operation in August 1982 has reached an operating time of 11,000 hrs. It serves in testing components of high-temperature gas-cooled reactors for direct heat application and for the steam cycle HTR-Module. Tests of a 10 MW U-tube heat exchanger, the cylindrical hot header of the He-heat exchangers, and a secondary hot gas duct have been successfully completed. Operation will be continued with tests of a 10 MW helical-tube heat exchanger, a 10 MW steam generator and primary and secondary hot gas duct test objects like bends and a coaxial duct. The availability of the test facility is better than 80%. (author). 20 figs.

36258 (IAEA-TECDOC—436, pp 429-443) **HTR fuel development and qualification: Treatment of spent fuel.** Kaiser, G.; Hackstein, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.); Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper gives a description of design and performance requirements for spherical HTGR fuel elements together with the fabrication technology and the irradiation qualification. Different options for spent fuel treatment are presented and discussed. (author). 19 refs, 8 figs, 3 tabs.

36259 (IAEA-TECDOC—436, pp 445-460) **Characteristics of HTGR spherical fuel elements.** Chernikov, A.S.; Permyakov, L.N.; Mikhajlichenko, L.I.; Kurbakov, S.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper presents the investigation results for the basic characteristics of spherical fuel element components: fuel microspheres (dimension, shape, density, structure, strength), pyrocarbon and silicon carbide coatings (thickness, density, macro- and microstructure, crystalline structure, thermal stability, gaseous fission product release, radiation stability etc.) and matrix graphite (density, effective thermal conductivity, linear thermal expansion coefficient, elasticity modulus, bending strength). In manufacturing fuel microspheres sol-gel process and slip-casting methods were used; coating deposition was accomplished in fluidized bed, high-density pyrocarbon coatings being deposited from CH_4-Ar or C_3H_6-Ar; SiC coatings - from CH_4-$SiCl_4$-H_2-Ar or CH_3SiCl_3-H_2-Ar mixtures; matrix graphite was prepared on the basis of bulk graphite fillers, 30 PG and MPG-6. (author). 13 refs, 8 figs, 3 tabs.

36260 (IAEA-TECDOC—436, pp 461-469) **Self-sustaining thorium cycle in a high temperature graphite reactor.** Balakrishnan, K. (Bhabha Atomic Research Centre, Bombay (India)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The paper contains results of studies for optimizing fuel utilization in HTGRs. Different U235 enrichments, core power densities and heavy metal concepts have been analyzed and results are presented and discussed. (author). 1 ref., 3 figs.

36261 (IAEA-TECDOC—436, pp 473-482) **Future applications of the high temperature reactor.** Klusmann, A.; Stelzer, M. (Ruhrkohle Oel und Gas GmbH, Bottrop (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The advanced reactor systems, the fast breeder and the high temperature reactor (HTR), have reached maturity for commercial use. At the same time nuclear energy is in a critical situation. In addition to reliability, safety, and competitiveness new requirements have come up for future projects in many countries. More safety, an easy fuel cycle, a wide variety of process applications, public acceptance and low environmental impacts are demanded by the public. The HTR can fulfil most of these criteria as is proven by the German prototype plants 15 MW AVR-Juelich and 300 MW THTR Schmehausen. The Federal Republic of Germany can contribute to the future use of nuclear energy a new safe reactor system with application possibilities beyond the electric power production. (author). 15 refs.

36262 **(UCRL—98235) Chernobyl source term, atmospheric dispersion, and dose estimation.** Gudiksen, P.H.; Harvey, T.F.; Lange, R. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 17p. (CONF-880367—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008886/JAW.

From SCOPE-ENUWAR workshop on the environmental consequences of nuclear war; Moscow, USSR (20 Mar 1988).

The Chernobyl source term available for long-range transport was estimated by integration of radiological measurements with atmospheric dispersion modeling, and by reactor core radionuclide inventory estimation in conjunction with WASH-1400 release fractions associated with specific chemical groups. These analyses indicated that essentially all of the noble gases, 80% of the radioiodines, 40% of the radiocesium, 10% of the tellurium, and about 1% or less of the more refractory elements were released. Atmospheric dispersion modeling of the radioactive cloud over the Northern Hemisphere revealed that the cloud became segmented during the first day, with the lower section heading toward Scandinavia and the uppper part heading in a southeasterly direction with subsequent transport across Asia to Japan, the North Pacific, and the west coast of North America. The inhalation doses due to direct cloud exposure were estimated to exceed 10 mGy near the Chernobyl area, to range between 0.1 and 0.001 mGy within most of Europe, and to be generally less than 0.00001 mGy within the US. The Chernobyl source term was several orders of magnitude greater than those associated with the Windscale and TMI reactor accidents, while the ^{137}Cs from the Chernobyl event is about 6% of that released by the US and USSR atmospheric nuclear weapon tests. 9 refs., 3 figs., 6 tabs.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 36191, 36416, 38652

36263 (INIS-BR—1079) Inspection of Candu Nuclear Reactor Fuel Channels. Baron, J.; Jarvis, G.N.; Dolbey, M.P.; Hayter, D.M. (Ontario Hydro, Toronto (Canada)). 1986. 23p. (CONF-8609282—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702777/JAW.

From 1. non destructive testing congress for Latin America and Caribbean; Sao Paulo, Brazil (21 Sep 1986).

The Channel Inspection and Gauging Apparatus of Reactors (CIGAR) is a fully atomated, remotely operated inspection system designed to perform multi-channel, multi-task inspection of CANDU reactor fuel channels. Ultrasonic techniques are used for flaw detection, (with a sensitivity capable of detecting a 0.075 mm deep notch with a signal to noise ratio of 10 dB) and pressure tube wall thickness and diameter measurements. Eddy currrent systems are used to detect the presence of spacers between the coaxial pressure tube and calandria tube, as well as to measure their relative spacing. A servo-accelerometer is used to estimate the sag of the fuel channels. This advanced inspection system was commissioned and declared in service in September 1985. The paper describes the inspection systems themselves and discussed the results achieved to-date.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 36325, 36326, 36372, 36375, 36376, 36377, 36378, 36379, 36380, 36381, 36382, 36432, 36434, 36441, 36451, 36720, 36727, 36728, 36732

36264 (CEA-CONF—9231) Codes and standards an European point of view. Roche, R.L.; Townley, C.H.A.; Corsi, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 5p. (CONF-870917—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753455/JAW.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

The first part of this paper is related to the European situation in which Construction Codes for FBR components are developed. Attention is given to the different agreements between European Countries. After a description of the present state of Codes development, indications are given on the future work in this field. Several appendix are devoted to the state of Codes in different European Countries and to the action of European Commission.

36265 (CEA-CONF—9236) Review of analysis methods about thermal buckling. Moulin, D.; Combescure, A.; Acker, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 21p. (CONF-8708256—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753458/JAW.

From Seminar on inelastic analysis and life prediction on high temperature environment; Lausanne, Switzerland (24 Aug 1987).

This paper highlights the main items emerging from a large bibliographical survey carried out on strain-induced buckling analysis methods applicable in the building of fast neutron reactor structures. The work is centred on the practical analysis methods used in construction codes to account for the strain-buckling of thin and slender structures. Methods proposed in the literature concerning past and present studies are rapidly described. Experimental, theoretical and numerical methods are considered. Methods applicable to design and their degree of validation are indicated.

36266 (CONF-880417—22) Current experimental activities for solid breeder development. Johnson, C.E.; Hollenberg, G.W.; Roux, N.; Watanabe, H. (Argonne National Lab., IL (USA); Pacific Northwest Lab., Richland, WA (USA); Japan Atomic Energy Research Inst., Tokai, Ibaraki). 1988. Contract W-31-109-ENG-38. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011982/JAW.

From International symposium on nuclear fusion technology; Tokyo, Japan (10 Apr 1988).

The current data base for ceramic breeder materials does not exhibit any negative features as regards to thermophysical, mechanical, and irradiation behavior. All candidate materials show excellent stability for irradiation testing to 3% burnup. In-situ tritium recovery tests show very low tritium inventories for all candidates. Theoretical models are being developed to accurately predict real time release rates. Fabrication of kilogram quantities of materials has been achieved and technology is available for further scale-up.

36267 (CONF-880506—7) Analyzing unprotected transients in metal fuel cores with the SAS4A accident analysis code. Tentner, A.M.; Birgersson, G.; Hill, D.J.; Kalimullah; Miles, K.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009952/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

In the search for new advanced reactor concepts with enhanced safety and economics, attention is now centered in the US on the development of Liquid Metal-Cooled Reactors (LMR) equipped with a metal fuel core. While metal fuel reactors present significant advantages over oxide fuel reactors during normal operation and protected transients, they also have desirable characteristics during low probability unprotected transients. The consequences of these transients are evaluated using the SAS4A code system[1]. The SAS4A code has been designed to simulate the events that occur in an LMR core during the initiating phase of a hypothetical severe unprotected accident such as the Transient Overpower (TOP) or loss of Flow (LOF) accidents. In order to adapt the SAS4A code to the analysis of metal fuel cores, new models have been developed, reflecting the special characteristics of these cores. This paper describes current SAS4A capabilities and emphasizes the influence of metal fuel characteristics on the whole core behavior during the accident.

36268 (CONF-880506—16) Experimental and analytical studies of passive shutdown heat removal from advanced LMRs [liquid metal reactors]. Pedersen, D.; Heineman, J.; Stewart, R.; Anderson, T.; Lottes, P.; Tessier, J. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010092/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

A facility designed and constructed to demonstrate the viability of natural convection passive heat removal systems as a key feature of innovative LMR Shutdown Heat Removal (SHR) systems is in operation at Argonne National Laboratory (ANL). This Natural Convection Shutdown Heat Removal Test Facility (NSTF) has investigated the heat transfer performance of the GE/PRISM passive design. This initial series of experiments simulates the air-side geometry of the PRISM Radiant Reactor Vessel Auxiliary Cooling System (RVACS). The NSTF operates in either a uniform heat flux mode and a uniform temperature mode at the air/guard vessel interface. Analysis of the RVACS performance data indicates excellent agreement with pretest analytical predictions. Correlation analysis presents the heat transfer data in a form suitable for use in LMR design and verification of analytical studies.

36269 (CONF-880506—18) Metal fuel safety performance. Miles, K.J. Jr.; Tentner, A.M. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011998/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

The current development of breeder reactor systems has lead to the renewed interest in metal fuels as the driver material. Modeling efforts were begun to provide a mechanistic description of the metal fuel during anticipated and hypothetical transients within the context of the SAS4A accident analysis code system. Through validation exercises using experimental results of metal fuel TREAT tests, confidence is being developed on the nature and accuracy of the modeling and implementation. Prefailure characterization, transient pin response, margins to failure, axial in-pin fuel relocation prior to cladding breach, and molten fuel relocation after cladding breach are considered. Transient time scales ranging from milliseconds to many hours can be studied with all the reactivity feedbacks evaluated.

36270 (CONF-880546—20) Integral data for fast reactors. Collins, P.J.; Poenitz, W.P.; McFarlane, H.F. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012039/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

Requirements at Argonne National Laboratory to establish the best estimates and uncertainties for LMR design parameters have lead to an extensive evaluation of the available critical experiment database. Emphasis has been put upon selection of a wide range of cores, including both benchmark, assemblies covering a range of spectra and compositions and power reactor mock-up assemblies with diverse measured parameters. The integral measurements have been revised, where necessary, using the most recent reference data and a covariance matrix constructed. A sensitivity database has been calculated, embracing all parameters, which enables quantification of the relevance of the integral data to parameters calculated with ENDF/B-V.2 cross sections.

36271 (CONF-880601—34) Centralized Reliability Data Organization (CREDO) assessment of critical component unavailability in liquid metal reactors. Koger, K.H.; Haire, M.J.; Humphrys, B.L.; Manneschmidt, J.F.; Setoguchi, K.; Nakai, R. (Oak Ridge National Lab., TN (USA); Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center; Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011847/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The Centralized Reliability Data Organization (CREDO) is the largest repository of liquid metal reactor (LMR) component reliability data in the world. It is jointly sponsored by the US Dept. of Energy (DOE) and the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan. The CREDO data base contains information on a population of more than 20,000 components and approximately 1500 event records. A conservative estimation is that the total component operating hours is approaching 2.2 billion hours. The work reported here focuses on the availability information contained in CREDO and the development of availability critical items lists. That is, individual components are ranked in prioritized lists from worst to best performers from an availability standpoint. Availability as used here is an inherent characteristics of the component and is not necessarily related to plant operability. A major observation is that a few components have a much higher unavailability factor than the average. The top fifteen components contribute 93%, 77%, and 87% of the total system unavailability for EBR-II, FFTF, and JOYO respectively. Critical components common to all three sites are mechanical pumps and electromagnetic pumps. Application of resources to these components with the highest unavailability will have the greatest effect on overall availability. All three sites demonstrate that low maintainability (i.e., long repair times), rather than unreliability (i.e., high failure rates), are the main contributors, by about a two-to-one margin, to liquid metal system unavailability.

36272 (CONF-880661—6) Benefits of vertical and horizontal seismic isolation for LMR [liquid metal reactor] nuclear reactor units. Wu, Ting-shu; Chang, Y.W.; Seidensticker, R.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009975/JAW.

From ASME pressure vessel and piping conference; Pittsburgh, PA, USA (19 Jun 1988).

Seismic isolation has been shown to be able to reduce transmitted seismic force and lower response accelerations of a structure. When applied to nuclear reactors, it will minimize seismic influence on the reactor design and provide a design which is less site dependent. In liquid metal reactors where components are virtually at atmospheric pressure but under severe thermal conditions, thinwalled structures are generally used for primary systems. Thinwalled structures, however, have little inherent seismic resistance. The concept of seismic isolation therefore offers a viable and effective approach that permits the reactor structures to better withstand thermal and seismic loadings simultaneously. The majority of published work on seismic isolation deals with use of horizontal isolation system only. In this investigation, however, local vertical isolation is also provided for the primary system. Such local vertical isolation is found to result in significant benefits for major massive components, such as the reactor cover, designed to withstand vertical motions and loadings. Preliminary estimations on commodity savings of the primary system show that, with additional local vertical isolation, the savings could be twice that estimated for horizontal isolation only. The degree of effectiveness of vertical isolation depends on the diameter of the reactor vessel. As the reactor vessel diameter increases, the vertical seismic effects become more pronounced and vertical isolation can make a significant contribution.

36273 (EUR—11306) Comparison of the containment codes used in the benchmark exercise from the modelling and numerical treatment point of view. Washby, V. (UKAEA United Kingdom Atomic Energy Authority, Warrington). (Commission of the European Communities, Luxembourg). 1987. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753961/JAW.

This report is the subject of a study contract sponsored by the containment loading and response group (CONT), a sub-group of the safety working group of the fast reactor co-ordinating committee - CEC. The analysises provided here will form part of a final report on containment codes, sensitivity analysis, and benchmark comparison, performed by the group in recent years. The contribution of this study contract is to assess the six different containment codes, used in the benchmark comparison, with regard to their procedures and methods, and also to provide an assessment of their benchmark calculation results, so that an overall assessment of their effectiveness for use in containment problems can be made. Each code description, which has been provided by the relevant user, contains a large amount of detailed information and a large number of equations, which would be unwieldy to reproduce and probably unnecessary. For this reason the report has concentrated on a fuller description of the SEURBNUK code, this being the code most familiar to the author, and other code descriptions have concentrated on noting variations and differences. Also, the code SEURBNUK/EURDYN has been used for the sensitivity analysis, this code being an extension of the original code SEURBNUK with the addition of axi-symmetric finite element capabilities. The six containment codes described and assessed in this report are those which were being actively used within the European community at the time.

36274 (UJV—7939-T) Statistical characteristics of turbulent flow in fast reactor fuel assembly periphery without spacers. Hejna, J.; Smid, J.; Cervenka, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Jun 1987. 86p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702956/JAW.

Method and results are presented of the turbulent flow microstructure measurement in a model of fast reactor fuel assembly periphery without wire wrap and spacers. The results of measurement (at Re=172000) and evaluation in form of normal and shear stresses, turbulent kinetic energy and eddy viscosity are compared

with the data for a circular tube and some literature data. (author). 69 figs., 18 tabs., 20 refs.

36275 **NEPTUNE: A system of finite element programs for three-dimensional nonlinear analysis.** Kulak, R.F.; Fiala, C. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nuclear Engineering and Design;* **106**: No. 1, 47-68(Feb 1988). Contract W-31-109-ENG-38.

This paper describes the NEPTUNE system of finite element codes that is being developed to assist in the design, safety evaluation, and licensing of metal and concrete reactor structures subjected to static or transient mechanical loads. The implementations of (1) a quadrilateral plate element for concrete, (2) a family of interface elements to treat contact and/or impact between structures, and (3) a silent boundary element are highlighted. Terse descriptions of the remaining elements in the code are given. The solution of the static equilibrium equations are obtained with the dynamic relaxation algorithms, and the equations of motion are solved with the central difference algorithm. The wide range of applicability of the code system is demonstrated with four examples. The propagation of a wave through a silent boundary is first illustrated. Then the impact of a deformable cylindrical container against a rigid floor is simulated. The final two problems deal with structural safety evaluations. The transient response of a liquid metal reactor's head assembly is first described, and then, a numerical simulation of the response of a 1/6-scale reinforced concrete light water reactor, containment model to static overpressurization is presented.

36276 **Analysis of primary containment response using an arbitrary Langrangian-Eulerian method.** Wang Chungyi. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nuclear Engineering and Design;* **106**: No. 1, 127-146(Feb 1988). Contract W-31-109-ENG-38.

This paper describes an advanced arbitrary Lagrangian-Eulerian method and its associated computer program, ALICE-II, for calculating the response of liquid metal reactor containment to core energetics. It is a versatile numerical algorithm with more flexibility and efficiency than other methods used to treat reactor containment with complex internals such as internal thin shells, upper internal structures, perforated plates, core-support diagrid, shield baffles, and deflector plates. The algorithm uses a two-dimensional, hybrid Lagrangian-Eulerian finite-difference technique to calculate the hydrodynamics and fluid-structure interactions, together with a purely Eulerian finite-difference approach to analyze the free-surface and material interface motions. It has significant advantages in treating complex phenomena such as flow through perforated structures, large material distortions, multi-dimensional sliding interfaces, flow around corners, highly contorted fluid boundaries, outflow boundary conditions, and coolant spillage. Numerical calculations for the hydrodynamic solutions are separated into three phases. The first phase consists of an explicit Lagrangian calculation. The second phase, which is options, contains an implicit iteration. The third phase, which is also optional, rezones the mesh vertices to prescribed positions. The structural response is computed by a library of elastic-plastic elements formulated in corotational coordinates in conjunction with an explicit time-integration scheme. Interaction between fluid and structure is accounted for by rigorously enforcing the interface boundary conditions. Many sample problems are given to illustrate the code effectiveness. Results demonstrate that these complex fluid-structure interaction problems can be analyzed with the ALICE-II code in a relatively natural and straightforward manner.

36277 **Integral fast reactor shows its mettle.** Chang, Y.I.; Lineberry, M.J.; Burris, L.; Waters, L.C. (Argonne National Lab., IL (USA)). *Nuclear Engineering International;* **32**: No. 400, 23-24, 26(Nov 1987).

Experiments and conceptual design work are progressing in the United States on a metal fuel alternative to the oxide fuel cycle for liquid-metal fast reactors. The fuel cycle is based on high-temperature metal reprocessing and injection-casting fabrication. Feasibility could be demonstrated at low cost in existing facilities. (U.K.).

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

36278 **(CONF-880702—2) Heat pump augmented radiator for low-temperature space applications.** Olszewski, M.; Rockenfeller, U. (Oak Ridge National Lab., TN (USA); Rocky Research Corp., Boulder City, NV (USA)). 1988. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008369/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Closed-cycle, space-based heat rejection systems depend solely on radiation to achieve their heat dissipation function. Since the payload heat rejection temperature is typically 50 K above that of the radiation sink in near earth orbit, the size and mass of these systems can be appreciable. Size (and potentially mass) reductions are achievable by increasing the rejection temperature via a heat pump. Two heat pump concept were examined to determine if radiator area reductions could be realized without increasing the mass of the heat rejection system. The first was a conventional, electrically-driven vapor compression system. The second is an innovative concept using a solid-vapor adsorption system driven by reject heat from the prime power system. The mass and radiator area of the heat pumpradiator systems were compared to that of a radiator only system to determine the merit of the heat pump concepts. Results for the compressor system indicated that the mass minimum occured at a temperature lift of about 50 K and radiator area reductions of 35% were realized. With a radiator specific mass of 10 kgm^2, the heat pump system is 15% higher than the radiator only baseline system. The complex compound chemisorption systems showed more promising results. Using water vapor as the working fluid in a single stage heat amplifier resulted in optimal temperature lifts exceeding 150 K. This resulted in a radiator area reduction of 83% with a mass reduction of 64%. 7 refs., 9 figs.

36279 **(CONF-880702—5) Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system.** Stovall, T.K.; Arimilli, R.V. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Mechanical and Aerospace Engineering). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88009714/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

A space-based thermal storage application must accept large quantities of heat in a short period of time at an elevated temperature. A model of a lithium hydride phase change energy storage system was used to estimate reasonable physical dimensions for this application which included the use of a liquid metal heat transfer fluid. A finite difference computer code was developed and used to evaluate three methods of enhancing heat transfer in the PCM energy storage system. None of these three methods, inserting thin fins, reticulated nickel, or liquid lithium, significantly improved the system performance. The use of a 95% void fraction reticulated nickel insert was found to increase the storage capacity (total energy stored) of the system slightly with only a small decrease in the system energy density (energy storage/system mass). The addition of 10% liquid lithium was found to cause minor increases in both storage density and storage capacity with the added benefit of reducing the hydrogen pressure of the lithium hydride. 9 refs., 7 figs., 2 tabs.

36280 **Military needs and requirements for multi-megawatt terrestrial power plants.** Atkinson, S.A.; Bowman, A.L. (Idaho National Engineering Lab., Idaho Falls, ID (US)). pp 1585-1590 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC07-76ID01570.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879336.

Numerous studies and actual electric grid power loss incidents and exercises have demonstrated the critical dependence of Air Force bases and their mission on electric power supply. One

result of the energy security evaluations of the Air Force is a goal to provide for on-base electric power generation. The Air Force requirements and desired attributes for on-base secure power generation have been defined, and a small nuclear power plant is found to have many advantages towards meeting both the requirements and the wants of the Air Force for secure power generation.

36281 **Heat transfer for ultra-high flux reactor.** Wadkins, R.P.; Lake, J.A.; Oh, C.H. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)). pp 134 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The use of a uniquely designed nuclear reactor to supply neutrons for materials research is the focus of recent reactor design efforts. The biological, materials, and fundamental physics aspects of research require neutron fluxes much higher than present research and testing facilities can produce. The most advanced research using neutrons as probing detectors is being done in the High Flux Reactor at the Institut Laue Langeuin, Frnace. The design of a reactor that can produce neutron fluxes of 1.0×10^{16} ncm^2 s requires a relatively high power (300 MW range) and a small core volume (approximately 30 liters). This combination of power and volume leads to a high power density which places increased demands on thermal hydraulic margins.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 36251, 36391, 36401

36282 **(AICE—8008927) The role of nuclear power in the energy future of the United States.** (American Inst. of Chemical Engineers, New York). Apr 1988. 13p. American Institute of Chemical Engineers, 1707 L Street, NW, Suite 333, Washington, DC 20036. Order Number TI88008927/JAW.

Nuclear energy offers a viable means of safely producing economical electric energy while minimizing depletion of US fossil resources and diminishing US reliance on oil and gas imports. However, the once-vigorous and growing US nuclear power industry has lost much of its vitality. Energy needs, environmental concerns, and continued reliance on electricity strongly indicate that nuclear plants should provide an increasing part of our energy supply. Failure to deal positively with the growing energy problems including stagnation of the nuclear power industry threatens the future economic well-being of the United States. To cope with today's state of nuclear stagnation, government and industry must deal with several factors including unstable regulatory requirements and policies, the political problems with the high-level waste disposal program, delays caused by extensive public intervention and litigation, mismanagement of nuclear power plants, and the general fear by the public of all things nuclear. Attempts to preserve nuclear power as a viable option for the future must acknowledge and resolve both institutional and technical issues. The topics discussed in this report and the recommendations therein constitute key steps to revitalize the nuclear option.

36283 **(EPRI-NP—5744) ASME [American Society of Mechanical Engineers] code, Section XI: 1985-1987 revisions and updates: Final report.** Mattu, R.K.; Anderson, W.F. (Science Applications International Corp., McLean, VA (USA)). May 1988. 355p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010645/JAW.

ASME Section XI, {open←quotes}Rules for Inservice Inspection of Nuclear Power Plant Components{close←quotes} provides rules for examination, testing, and inspection of components and systems in a nuclear power plant. New editions of Section XI are issued every 3 years, and Addenda, which include additions and revisions to each Edition of the Code, are published once a year. This report covers ASME Section XI updates (proposed and approved), related NRC activities, information on O and M Standards dealing with pumps and valves, and snubbers and special issues such as personnel qualification and training for the period from June 1985 through June 1987. Summary information is also provided on Utility Inservice Inspection and Inservice Testing (ISI/IST) program results, relief requests, and current issues like plant life extension/plant aging, repair and replacement programs (steam generator, BWR piping, etc.), maintenance programs, performance indicators, check valves, and BOP inspections.

36284 **(IAEA-INSAG-TN—1) Towards improvement in quality assurance. Report by the International Nuclear Safety Advisory Group.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701984/JAW.

This first document in the series of the International Nuclear Safety Advisory Group (INSAG) Technical Notes is a general guideline for the establishment of effective quality assurance procedures at nuclear facilities. It sets out primary requirements such as quality objectives, methods for measuring the effectiveness of the quality assurance programme, priority of activities in relation to importance of safety of items, motivation of personnel.

36285 **(NUREG—0040-Vol.12-No.1) Licensee contractor and vendor inspeecxtion status report: Quarterly report, January 1988-March 1988.** (Nuclear Regulatory Commission, Washington, DC (USA)). May 1988. 127p. NTIS, PC A07/MF A01 - GPO;3. Order Number TI88011849/JAW.

This periodical covers the results of inspections performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organizations during the period from January 1988 through March 1988. Also included in this issue are the results of certain inspections performed prior to January 1988 that were not included in previous issues of NUREG-0040.

36286 **(NUREG—0540-Vol.10-No.3) Title list of documents made publicly available, March 1-31, 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). May 1988. 385p. NTIS, PC A17 - GPO;3. Order Number TI88010592/JAW.

This document is a monthly publication containing descriptions of information received and generated by the US NRC. This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author Index, Corporate Author Index, Report Number Index, and Cross Reference to Principal Documents Index.

36287 **(NUREG—0750-Vol.27-No.2) Nuclear Regulatory Commission issuances, February 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Feb 1988. 221p. NTIS, PC A10/MF A01 - GPO;1. Order Number TI88009561/JAW.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

36288 **(NUREG—0750(Vol.27)(No.3)) Nuclear Regulatory Commission issuances, March 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Mar 1988. 84p. NTIS, PC A05/MF A01 - GPO;1; GPO Dep. Order Number TI88010236/JAW.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

36289 **(NUREG—1214-Rev.3) Historical data summary of the systematic assessment of licensee performance.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation). May 1988. 70p. NTIS, PC A04 - GPO;3. Order Number TI88010249/JAW.

The Historical Data Summary of the Systematic Assessment of Licensee Performance (SALP) is produced periodically by the US Nuclear Regulatory Commission. This summary provides the results of the assessment for each facility by NRC region and is further divided into the following three sections: Section 1 presents the most recent SALP report ratings for facilities under construction and in operation. Section 2 presents a chronological listing of all SALP report ratings for each operating facility. Section 3 presents a chronological listing of all SALP report ratings for each facility under construction. For historical purposes, past construction SALP ratings for facilities that recently have been licensed also are listed in Section 3.

36290 **(SAND—87-7136) US national and regional impacts of nuclear plant life extension.** Makovich, L.; Forest, L.; Fletcher, T. (DRI Energy Service, Lexington, MA (USA); DRI Project and Product Consulting, Washington, DC (USA)). Jan 1988. Contract AC04-76DP00789. 214p. NTIS, PC A10;3. Order Number DE88007317/JAW.

The US will need new sources of electricity in the early 21st century due to retirement of much of the nation's generating capacity. Almost all of the US nuclear capacity would be included in those retirements if, as originally expected, the nuclear units were shut down and decommissioned as the operating licenses expired between 2005 and 2025. However, given the large demands for new capacity during that period, nuclear plant life extension (NUPLEX) – the extension of operating life beyond the original license period – needs to be considered as an electricity source. This study assesses the benefits and costs of NUPLEX relative to the anticipated competing sources of electricity supply in the early 21st century. We find that NUPLEX yields large net benefits under a wide range of plausible economic conditions. This study associates net benefits with electricity cost savings, thereby abstracting from speculative reliability considerations. To illustrate the effects of uncertainty, the study assesses NUPLEX net benefits under varying assumptions on NUPLEX investment costs and other future economic conditions.

36291 **(SAND—88-1416C) Methodology to identify, review, and evaluate components for license renewal.** Carlson, D.D.; Gregor, F.E.; Walker, R.S. (Sandia National Labs., Albuquerque, NM (USA); Multiple Dynamics Corp., Southfield, MI (USA); Grove Engineering, Gaithersburg, MD (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880748—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011200/JAW.

From American Nuclear Society topical meeting on nuclear power plant life extension; Snowbird, UT, USA (31 Jul 1988).

A methodology has been developed to systematically identify, review, and evaluate plant equipment for license renewal. The method builds upon the existing licensing basis, operating history, and accepted deterministic and probabilistic techniques. Use of these approaches provides a focus for license renewal upon those safety-significant systems and components that are not routinely replaced, refurbished, or subject to detailed inspection as part of the plant's existing test, maintenance, and surveillance programs. Application of the method identified the PWR and BWR systems that should be subjected to detailed license renewal review. Detailed examination of two example systems demonstrates the approach. The review and evaluation of plant equipment for license renewal differ from the initial licensing of the plant. A substantial operating history has been established, the licensing basis has evolved from the original one, and plant equipment has been subject to periodic maintenance and surveillance throughout its life. In consideration of these differences, a basis for license renewal is needed. License renewal should be based upon continuation of the existing licensing basis and recognition of existing programs and operating history.

2108 Economics

REFER ALSO TO CITATION(S) 36254, 36267, 36843

36292 (IAEA-TECDOC—436, pp 483-497) **Financing models for HTR plants: Co-financing, counter trade, joint ventures.** Bogen, J.; Stoelzl, D. (Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

Structure and volume of investment cost for HTR nuclear power plants are different in comparison to other types of nuclear power plants. Even if the share of local participation is in comparable order of magnitude to other nuclear power plants, the required technical infrastructure for HTR plants is more suitable for existing and still practised technologies in countries which are in development processes. These HTR specific features offer special possibilities in HTR project financing. Various models are discussed in respect of the special HTR situation. Even if it is not possible to point out in a general manner the best solution - due to national, local and time dependant situations - this paper discusses the HTR specific impacts to buyer's credit financing, supplier's credit financing, barter trades or joint ventures and combined financing. (author). 4 refs, 9 figs.

36293 (IAEA-TECDOC—436, pp 499-509) **Perspectives on the HTGR from utilities in the USA.** Brey, H.L.; Mears, L.D. (Public Service Co. of Colorado, Denver (USA); Gas-Cooled Reactor Associates, San Diego, CA (USA)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The Gas Cooled Reactor Associates (GCRA) represents utility/user interests within the United States in establishing and achieving HTGR program objectives. GCRA conducts Demonstration Project development activities, plus provides overall program coordination/integration support services to the U.S. Department of Energy. This paper summarizes three of the activities currently being undertaken by GCRA. These include: The 1986 Summary of the United States Utility/User Questionnaires concerning new electrical generating capacity, the future of nuclear power, and the potential of the HTGR; The utility/user requirements for the modular HTGR plant, and An update on the modular HTGR Demonstration Project development activities. (author). 3 refs, 11 figs.

36294 (IAEA-TECDOC—436, pp 511-519) **Market prospects of HTRs in newly industrialized and developing countries.** Garriba, S.; Vivante, C. (Politecnico di Milano (Italy); Commission of the European Communities, Brussels (Belgium)). Oct 1987. NTIS (US Sales Only), PC A23/MF A01. Order Number DE88701817/JAW. (CONF-8610160—).

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

Some unique characteristics seem to make HTR a nuclear system suitable to cope with future power and energy supply needs of a developing world. Aspects which deserve consideration are economics, technological flexibility, safety and proliferation issues. As compared with other nuclear reactor concepts, HTRs can be constructed into relatively small sizes according to a standardized approach. This characteristic renders the reactor suitable to be introduced in power grids of limited extension. The small size allows to increase the installed power generating capacity by following the variable trend of demand, all within a short construction period. The high degree of inherent safety makes the reactor system especially resistant to equipment failures and mismanagement. Safety and high-temperature features would allow the use of the reactor for supplying steam and process heat a newly industrializing country may need. In principle, non-proliferation records of HTRs depend upon the type of nuclear fuel and nuclear fuel cycle. If low-enriched or medium-enriched uranium is used, reprocessing would not be necessary. The exhausted fuel can be easily accommodated

and stored before ultimate disposal. Finally, as for its relation with the local context, HTR entails flexible arrangements, which can be adapted to participation and seem suitable to technology transfer. Given these opportunities, it can be suggested that forms of co-operation with developing countries are looked for to monitor technology progress and prepare appropriate solutions. (author). 8 refs.

36295 **(SAND—88-0084C) State of technology assessment for life extension of electrical and I & C equipment in nuclear power plants.** DuCharme, A.R.; Boger, R.M.; Meyer, L.C.; Beament, P.R. (Sandia National Labs., Albuquerque, NM (USA); Westinghouse Hanford Co., Richland, WA (USA); EG and G Idaho, Inc., Idaho Falls (USA); Virginia Power Co., Richmond (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880748—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011249/JAW.

From American Nuclear Society topical meeting on nuclear power plant life extension; Snowbird, UT, USA (31 Jul 1988).

As part of the IEEE Working Group 3.4 on Nuclear Plant Life Extension, an assessment is made of the current state of technology for the life extension of certain classes of electrical and I&C equipment. The classes investigated include motors, cables, emergency diesel generators, penetrations, inverters/chargers, switchgear, and reactor protection systems. The work is focussed on assessment of current or recently completed R&D efforts to resolve issues affecting life extension of the equipment. Aspects discussed include the degree of resolution of these issues, potentially affected standards, and technical aspects requiring further research. 15 refs., 2 tabs.

36296 **Construction-man hour estimation for nuclear power plants.** Paek, J.H. Austin, TX; Univ. of Texas (1987). 139p. University Microfilms Order No. 87-17,503.

Thesis (Ph. D.).

This study centers on a statistical analysis of the preliminary construction time, main construction time, and total construction man hours of nuclear power plants. The use of these econometric techniques allows the major man hour driving variables to be identified through multivariate analysis of time-series data on over 80 United States nuclear power plants. The analysis made in this study provides a clearer picture of the dynamic changes that have occurred in the man hours of these plants when compared to engineering estimates of man hours, and produces a tool that can be used to project nuclear power plant man hours.

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 36184

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 36316, 36369, 36442, 36444, 36445, 36446, 36447, 36449

36297 **(FEI—1720) Three-dimensional schemes in the method of non-total factorization.** Buleev, N.I.; Ledovskij, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 17p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701963/JAW.

Three-dimensional schemes for non-total factorization in solving difference equations of the diffusion type are reviewed. The derivation of equations in running coefficients of the scheme with the run according to the third coordinate and with the explicit scheme in a two-dimensional plane of two first coordinates is described in detail. The results of test calculation of the simulating problem with boundary conditions of the first type are given for this scheme. Equations determining running coefficients are given for other schemes, otherwise differences, being possessed in one or another scheme modification, are described. The schemes described permit efficiently to solve difference equations approximating differential elliptical equations of the different type. 12 refs.

36298 **(IAE—4308/4) Constants of delayed neutrons.** Manevich, L.G.; Nemirovskij, P.Eh.; Yudkevich, M.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701975/JAW.

Experimental data on the probability of neutron emission P/sub n/ during fission fragment decay are evaluated. On the basis of the data on P/sub n/ and fragment yields the yields of delayed neutrons ν/sub d/ per one fission act in the processes of thermal fission of /sup 233,235/U, /sup 239,241/Pu and fission of ^{232}Th, /sup 235,238/U, ^{230}Pu in the fission spectrum range are calculated. With somewhat lower accuracy ν/sub d/ is obtained for /sup 233,236/U, ^{237}Np, /sup 240,241,242/Pu fast fission and ^{232}Th, /sup 233,235,238/U and ^{239}Pu fission by 14-MeV neutrons. Evaluation calculations of ν/sub d/ are made for exotic nuclei ^{229}Th, ^{238}Pu, ^{241}Am, /sup 243,244,245,247/Cm. For the main fission isotopes the time dependence of neutron activity drop after irradiation is calculated. 6-group constants are obtained. All the values obtained are compared with the results of macroscopic measurements. The 6-group constants comparison is made as applied to reactivity measurement using the method of reversed solution of kinetic equation. 27 refs.3 figs.; 14 tabs.

36299 **(IKE—6-172) ICM2D, a program for solving multigroup neutron transport problems in (x,y) geometry applying the J^{+-}-concept with consistent partial current coupling.** Rueckle, T.; Emendoerfer, D. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Apr 1987. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753548/JAW.

This program has been developed for fast, two-dimensional transport calculations, on the theoretical basis of the method of consistent partial current coupling. The report explains the method and the characteristics of the ICM2D program. It is suitable to calculating multigroup neutron distributions in fuel elements with homogenized fuel rod cells. Defining the mesh size to be that of the homogenized fuel rod cell, the accuracy of the solution is near the S/sub N/-solution of the order 4. A sub-division of meshes reduces the accuracy. The computing times for solving two-dimensional multigroup transport problems are significantly reduced with the ICM2D program, compared to the S/sub N/-method.

36300 (INIS-SU—10, pp 40-46) **On possibility of vibrational stabilization in nuclear instable stationary regimes in nuclear reactors.** Trakhtenberg, A.M. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780094/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; (No. 2).

In Physics and technology of nuclear reactors.

A principle possibility of applying the vibrational stabilization method to nuclear reactors is studied. The problem of securing the stability of nuclear reactor operation steady-state regimes is one of the central ones in dynamics theory and nuclear reaction operation experience. In particular, the problem of xenon oscillation suppressing in a reactor, occuring as a result of steady-state regime instability is urgent. Investigation is conducted using the simpliest reactor model, repesenting it as a non-linear object with concentrated parameters. It is proved that vibrational stabilization is achieved by periodic fluctuations of the control rod positions in the reactor core and boric acid concentration in the coolant with period $1s<T<3x10^4s$. In practice stabilization is effective, when the steady-state regime is located near the stability boundary, which appears to be dangerous, i.e. self-oscillations with inadmissibly high amplitude occure in the reactor.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 36345, 36389, 36716, 36724, 36732, 36769, 36770, 37342, 39019

36301 (AD-A—190258/4/XAB) Design, construction, and testing of an in-pile loop for PWR (Pressurized Water Reactor) simulation. Master's thesis. Wicks, J.H. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Ocean Engineering). Jun 1987. 130p. NTIS, PC A07/MF A01.

Corrosion-product activation and transport in Light Water Reactors is a well-recognized, but poorly understood phenomenon, despite studies conducted worldwide for the past 20 years. In an effort to determine the mechanistic parameters that produce and release the transport activated corrosion products throughout a typical Pressurized Water Reactor (PWR), MIT has undertaken the construction of a model pressurized-water loop to simulate the thermal hydraulic characteristics of a representative full-scale PWR. This report presents the final detailed design of the PCCL. As-built, the loop duplicates the core and steam generator fluid surface film differential temperatures, bulk fluid temperatures, and wall fluid shear stress of an actual PWR. Included are proposed plans for seatrial testing of the initial loop prior to research operation. The final design was reviewed and authorized for construction by the PCCL Project Staff and the MIT Reactor Safeguards Committee.

36302 (CEA-CONF—9234) Sextant: an expert system for transient analysis of nuclear reactors and integral test facilities. Barbet, N.; Dumas, M.; Mihelich, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 8p. (CONF-870832—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753456/JAW.

From Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry; Snowbird, UT, USA (31 Aug 1987).

Expert systems provide a new way of dealing with the computer-aided management of nuclear plants by combining several knowledge bases and reasoning modes together with a set of numerical models for real-time analysis of transients. New development tools are required together with metaknowledge bases handling temporal hypothetical reasoning and planning. They have to be efficient and robust because during a transient, neither measurements nor models, nor scenarios are hold as absolute references. SEXTANT is a general purpose physical analyzer intended to provide a pattern and avoid duplication of general tools and knowledge bases for similar applications. It combines several knowledge bases concerning measurements, models and qualitative behavior of PWR with a mechanism of conjecture-refutation and a set of simplified models matching the current physical state. A prototype is under assessment by dealing with integral test facility transients. For its development, SEXTANT requires a powerful shell. SPIRAL is such a toolkit, oriented towards online analysis of complex processes and already used in several applications.

36303 (CONF-880601—33) TEM [transmission electron microscopy], APFIM [atom-probe field ion microscopy], and SANS [small-angle neutron scattering] examination of aged duplex stainless steel components from some decommissioned reactors. Chung, H.M.; Chopra, O.K. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 10p. (CONF-880601—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009984/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The present investigation indicates that the primary embrittlement processes of the CF-8 grade cast stainless steel components during extended reactor service are spinodal decomposition of the ferrite phase and $M_{23}C_6$ carbide precipitation on the austenite-ferrite boundaries. The ferrite hardness measured for the Shippingport reactor valves appears to reflect the different extent of spinodal decomposition among the different valves which contain slightly different Cr contents. G-phase precipitation was minimal compared to that during accelerated aging of CF-8 steel in the laboratory (i.e., near 400{degree}C). This indicates that the activation energy may be strongly influenced by the synergism among the G-phase precipitation, carbide formation, and spinodal decomposition. 13 refs., 2 figs.

36304 (CONF-8805141—2) Crack arrest behavior of reactor pressure vessel steels at high temperatures. Pugh, C.E.; Naus, D.J.; Bass, B.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011833/JAW.

From IAEA specialists' meeting on fracture mechanics verification by large-scale testing; Stuttgart, F.R. Germany (25 May 1988).

The Heavy-Section Steel Technology Program at the Oak Ridge National Laboratory under the sponsorship of the US Nuclear Regulatory Commission is conducting experimental and analytical studies to improve the understanding of conditions that govern the initiation, rapid propagation, arrest and ductile tearing of cracks in reactor pressure vessel (RPV) steels. In support of this objective, large-scale wide-plate experiments are performed to generate crack-arrest toughness data for RPV steels at temperatures approaching and above the onset of Charpy upper-shelf behavior. Analytical studies are addressing the role of dynamics and nonlinear rate-dependent (i.e., viscoplastic) effects in the interpretation of crack run-arrest events in these ductile materials. A summary of the wide-plate tests performed to date is presented, including details of test procedures, test data, and results of analyses performed to date. The importance of incorporating viscoplastic effects into dynamic analysis of crack run-arrest events in these strain-rate sensitive steels is examined through applications of selected proposed viscoplastic constitutive equations and fracture parameters to the interpretation of data from the wide-plate tests. The crack-arrest data are compared with those from small ASTM-type specimens and other large structural tests.

36305 (EPRI-NP—5697) Valve stem packing improvements: Final report. Ruggieri, S.K.; Kelly, J.S. (Electric Power Research Inst., Palo Alto, CA (USA)). May 1988. 387p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011367/JAW.

Valve stem seal leakage has been the direct cause of a significant number of events which resulted in the shutdown of nuclear power plants. It has also been a major contributor to the maintenance effort required in these power plants. The overall objectives of this project were to: identify the root causes of selected events related to improper performance of valve stem seal systems, develop the means to permanently correct the performance deficiencies, evaluate the corrective actions in full-scale laboratory testing and in-plant evaluations, and provide for the technology transfer of the recommended corrective actions. Specific achievements detailed in this report include: the development of valve stem sealing systems that effectively control valve stem leakage, an extensive laboratory evaluation of these improved systems at full scale under simulated plant conditions, an extensive testing program to evaluate both the need for and relative effectiveness of corrosion inhibitors, and installation of the improved valve stem sealing system in an operating plant. The project was conducted in two phases. The activities and results of Phase 1 are published in EPRI Report NP-4255 (February 1986). This final report includes the activities and results of both Phase 1 and Phase 2.

36306 (FEI—1828) Heat and mass transfer in a transport channel. Matyushina, S.A.; Opanasenko, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701968/JAW.

Heat and mass transfer in transport channels of a fast reactor charging complex is investigated. Results of studying mass transfer and temperature conditions in a model channel 430 mm in diameter and with relative length of 9.3 connecting heated gas (argon) cavity and environment are presented. Mathematical model for calculating fields of temperature and gas velocities with provision for diffusion based on solution of the Navier-Stokes equations in the Helmholtz form is considerd. The data obtained show that at similar conditions mass transfer is characterized with instability; it is proportional in value to a temperature difference between gas cavities. Mount-

ing of a cooling heat exchanger in the upper channel section along its 1/3 length leads to static gaseous lock abruptly decreasing mass transfer. 4 refs.; 4 figs.

36307 **(IAE—4309/4) Technique for probabilistic calculation of brittle fracture of power plant pressure vessels.** Tkachev, V.V.; Tutnov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701976/JAW.

Technique for probabilistic calculation of brittle fracture of power plant pressure vessels is presented. Effect of static spread in data on mechanical material properties, defect sizes and errors of nondestructive test means on the accuracy of brittle fracture time prediction is taken account of. Example of probabilistic calculation of nuclear reactor vessel fracture during its operation is given. 6 refs.; 2 figs.

36308 **(INIS-BR—964) Contribution for stress analysis in bend acessories of piping systems.** Melo, F.J.M.Q. de; Castro, P.M.S.T. de. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1986. 15p. (In Portuguese). (CONF-8610317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701618/JAW.

From 4. Brazilian symposium on piping and pressure vessels; Salvador, BA, Brazil (28 Oct 1986).

Analytical and numerical studies of the linear elastic behavior of bend pipes, with tangent pipes or flanged ends, such as used in nuclear power plants are presented. Two analytical techniques were developed; one is based on the integration of Euler equation and the other one is based on a Fourier analysis. The results obtained using these approaches are compared with results obtained by a finite element code for 'semiloof shells.

36309 **(INIS-BR—965) Elastic-plastic analysis of part-through crack propagation in piping and pressure vessels.** Souza, L.A. de; Ebecken, N.F.F. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1986. 13p. (In Portuguese). (CONF-8610317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701619/JAW.

From 4. Brazilian symposium on piping and pressure vessels; Salvador, BA, Brazil (28 Oct 1986).

The shell structures, often used in the construction of reservoirs, pipings, pressure vessels, nuclear power plants, etc, with part-through crack along its thickness, are analysed, using a computer system developed by the finite element method. The surface is discretized with three-dimensional quadratic elements, degenerated in its mid-surface, such the fracture is simulated by scalar elements (non linear springs). The results are analysed by the stress intensity factor K Sub(I) and the strain energy release rate, which is known as J-integral. The analysis is performed in the elastic and elastic-plastic regime. The basic hipothesis and the formulation adopted in the derivation of the scalar elements are also shown.

36310 **(INIS-BR—966) Dynamic analysis of pipings by Modal Synthesis.** Augusto, O.B.; Mattar Neto, M. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1986. 13p. (In Portuguese). (CONF-8610317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701620/JAW.

From 4. Brazilian symposium on piping and pressure vessels; Salvador, BA, Brazil (28 Oct 1986).

A Modal Synthesis method, the component modes, and its implementation as a post-processor of finite element program is presented. Examples of calculations of stationary and transient vibrations for monitoring pipelines of nuclear power plants are analysed. (M.C.K.).

36311 **(INIS-BR—967) Qualification of expansion and welding procedures of tube-to-tubesheet joints for heat exchangers in nuclear power plants.** Camargo, G.D.M.; Couto, J.G.V.; Castro, L.A.S. de. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1986. 18p. (In Portuguese). (CONF-8610317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701621/JAW.

From 4. Brazilian symposium on piping and pressure vessels; Salvador, BA, Brazil (28 Oct 1986).

Leaking tube to tubesheet joints are among the most frequent defects detected in the operation of tubular heat exchangers. This kind of problem requires a special treatment, in the case of heat exchangers intalled in nuclear power plants, aiming at a minimum of leakages and further repair outages. The criteria used for the pre-qualification of tube-to-tubesheet joints, is described, and the experiences acquired during the tests and fabrication of several components supplied by national manufacturers, are presented.

36312 **(INIS-BR—970) Stress in pressurized spheres with imperfections.** Godoy, L.A.; Flores, F.G. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1986. 11p. (In Spanish). (CONF-8610317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701624/JAW.

From 4. Brazilian symposium on piping and pressure vessels; Salvador, BA, Brazil (28 Oct 1986).

Stresses due to geometric imperfections in pressurized thin spherical shells, which are used in containments of nuclear reactors and steam generation systems are studied. The analysis is carried out discretizing the imperfect geometry by finite element method.

36313 **(INIS-BR—971) Seismic analysis of a containment vessel.** Toledo, E.M.; Loula, A.F.D.; Jospin, R.J. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1986. 18p. (In Portuguese). (CONF-8610317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701625/JAW.

From 4. Brazilian symposium on piping and pressure vessels; Salvador, BA, Brazil (28 Oct 1986).

A seismic analysis of a nuclear power plant's steel containment vessel is presented. Visual loads in this kind of analysis like SSE, DBE and SSB loadings are considered. With the response spectra previously obtained, for these loadings, one uses the response spectrum techniques in order to obtain estimatives for the maximum values of the stresses. Some considerations about the problem and the approach used for the solution, are initially described. Next, the analysed structure geometry and some results, compared with those obtained by using ANSYS computer code, is showed.

36314 **(INIS-BR—972) Seismic analysis of structures of nuclear power plants by Lanczos mode superposition method.** Coutinho, A.L.G.A.; Alves, J.L.D.; Landau, L.; Lima, E.C.P. de; Ebecken, N.F.F. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1986. 20p. (In Portuguese). (CONF-8610317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701626/JAW.

From 4. Brazilian symposium on piping and pressure vessels; Salvador, BA, Brazil (28 Oct 1986).

The Lanczos Mode Superposition Method is applied in the seismic analysis of nuclear power plants. The coordinate transformation matrix is generated by the Lanczos algorithm. It is shown that, through a convenient choice of the starting vector of the algorithm, modes with participation factors are automatically selected. It is performed the Response Spectra analysis of a typical reactor building. The obtained results are compared with those determined by the classical aproach stressing the remarkable computer effectiveness of the proposed methodology.

36315 (INIS-mf—11222, pp 46-56) **Dynamic diagnostics of the structure and components of a nuclear power plant during construction and operation.** Juhasova, E. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Stavebnictva a Architektury). 1987. (In Slovak). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The demands are discussed put on the dynamic diagnostics of engineering structures and components of nuclear power plants during their construction and operation. The said measurements are made using field and laboratory tests. Suitable sources of vibration are characterized and the results are described of tests of seismic resistance of ceramic insulators and their steel suports on an elec-

trohydraulically controlled seismic table. It is recommended that during the construction of a nuclear power plant dynamic measurements should be made of structures and components using all available vibration sources and that the main production unit and its key components should be provided with seismometric instruments. (Z.M.). 7 figs., 2 tabs., 12 refs.

36316 **(ITEF—73(1987)) Method of three-dimensional calculation of a heterogeneous reactor in the dipole approximation.** Malofeev, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702097/JAW.

Method of three-dimensional calculation of heterogeneous reactor in the dipole approximation is presented. This method is based on difference transformation of heterogeneous reactor theory equations and on Fourier cine expansion of neutron flux axial constituent. The method is realized in the TRECD program developed on the basis of the monopole TREC program permitting to calculate reactors with the large number of channels. Results of monopole and dipole calculations according to the TRECD program and direct two-dimensional DISHER program illustrating the difference method accuracy are given. 8 refs.

36317 **(NUREG/CR—4932) Close of IE Bulletin 80-03: Loss of charcoal from standard Type 2, two-inch, tray adsorber cells.** Dean, R.S.; Foley, W.J.; Hennick, A. (Parameter, Inc., Elm Grove, WI (USA)). Apr 1988. 26p. (PARAMETER/IE—167). NTIS, PC A03/MF A01 - GPO. Order Number TI88009217/JAW.

IE Bulletin 80-03 was issued on February 6, 1980, because of concern about defective charcoal tray adsorber cells found in certain ventilation systems at the Sequoyah Nuclear Plant. Some charcoal cells are used in special engineered safety feature (ESF) filtration systems. Others are installed in normal ventilation systems to control radioactive materials during expected operations, in compliance with 10 CFR 50 Appendix I. Licensees of operating power reactors were required to take four specific actions. Holders of construction permits for power reactors were required to take two specific actions. A copy of IE Bulletin 80-03 and a synopsis of the required actions are included in Appendix A. Evaluation of utility responses and NRC/Region inspection reports is documented in Appendix B as the basis for bulletin closeout by means of specific criteria (see Page 4 of the report text). A followup item is proposed in Appendix C for use by the NRC in assuring satisfactory completion of corrective action. Abbreviations used in this report and associated documents are presented in Appendix D. 3 refs.

36318 **(NUREG/CR—5159) Prediction of check valve performance and degradation in nuclear power plant systems: Final report, September 1987--April 1988.** Kalsi, M.S.; Horst, C.L.; Wang, J.K. (Kalsi Engineering, Inc., Sugar Land, TX (USA)). May 1988. 76p. (KEI—1559). NTIS, PC A05/MF A01 - GPO. Order Number TI88011557/JAW.

Degradation and failure of swing check valves and resulting damage to plant equipment has led to a need to develop a method to predict performance and degradation of these valves in nuclear power plant systems. This Phase I investigation developed methods which can be used to predict the stability of the check valve disk when piping disturbances such as elbows, reducers, and generalized turbulence sources are present upstream of the valve within 10 pipe diameters. Major findings include the flow velocity required to achieve a full open, stable disk position, the magnitude of disk motion developed with these upstream disturbances with flow velocities below full open conditions, as well as disk natural frequency data which can be used to predict wear and fatique damage. Reducers were found to cause little or no performance degradation. Elbow effects must be considered when located within 5 diameters of the check valve, while severe turbulence source have significant effect at distances to 10 diameters. Clearway swing check designs were found to be particularly sensitive to manufacturing tolerances and installation variable making them likely candidates for premature failure. Reducing the disk full opening angle on these clearway designs in significant performance improvement.

36319 **(SAND—87-2121C) US DOE nuclear power equipment performance prediction program.** DeBey, T.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880661—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007202/JAW.

From ASME pressure vessel and piping conference; Pittsburgh, PA, USA (19 Jun 1988).

As part of their commercial nuclear power plant lifetime improvement effort, the DOE Technology Management Center at Sandia National Laboratories has initiated the development of predictive performance monitoring techniques for extending the operational life of nuclear power plants. Such techniques could offer an attractive alternative to potentially expensive equipment replacement or refurbishment. In addition to such a program helping to provide a basis for the regulatory authorities on which to permit extended operation, an effective monitoring program would be valuable in improving equipment reliability and safety during the initial license term. This effort has involved correlating component parameters with dominant failure modes and identifying potential monitoring techniques for those parameters. The current focus of this work is on emergency diesel generators that are vital safety components in nuclear power plants. A test lab has been assembled to examine the potential of specific monitoring techniques on diesel engines.

36320 **(SAND—87-2336C) Development of a {open<--quotes}combined environments{close<--quotes} life prediction methodology applicable to ambient nuclear power plant cable aging simulations.** Gillen, K.T.; Clough, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 21p. (CONF-880748—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011489/JAW.

From American Nuclear Society topical meeting on nuclear power plant life extension; Snowbird, UT, USA (31 Jul 1988).

Based on analogies to the Arrhenius approach for aging predictions in thermooxidative environments, we have derived a predictive methodology appropriate to combined radiation-thermal environments. It is shown how the approach manipulates data from accelerated environmental conditions to make meaningful predictions for low voltage cables under dose-rate/temperature conditions characteristic of ambient nuclear power plant aging. Since analyses are only possible for homogeneously-oxidized materials, calculations are included which give strong evidence that homogeneous oxidation is appropriate to the ambient nuclear power plant aging of most low voltage cables. Data consistent with the methodology are presented for a number of cable materials.

36321 **(SAND—87-2797C) US DOE nuclear plant equipment performance prediction.** DeBey, T.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880748—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010836/JAW.

From American Nuclear Society topical meeting on nuclear power plant life extension; Snowbird, UT, USA (31 Jul 1988).

As part of the US Department of Energy (DOE) commercial nuclear power plant lifetime improvement effort, Sandia National Laboratories has initiated a project to investigate predictive performance monitoring techniques. The goal is to improve current equipment operation and to extend the operational life of the equipment. Early detection of equipment degradation and failure play an important role in the effort to extend plant life and also provide improved operation of all plants, new and old, through improved reliability and safety. For the plant life extension period, prognostic monitoring techniques could offer an attractive alternative to time-consuming and potentially expensive equipment replacement or refurbishment. This paper discusses the investigation of two important nuclear plant items for performance prediction methodologies: emergency diesels and steam turbines generators. 4 refs., 4 figs.

36322 **(SAND—88-1537C) Post-test analysis of a piping penetration in a 1:6-scale model of a reinforced concrete containment building.** Weatherby, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880616—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011816/JAW.

From 4. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (15 Jun 1988).

An overpressurization experiment was conducted on a scale-model of a reinforced concrete containment building. The test was terminated at an internal pressure of 145 psig due to excessive leakage through tears that developed in the steel liner. Virtually all leakage occurred through a 22-inch tear that propagated along the edge of a thickened insert plate that surrounded a piping penetration. This paper describes the results of a post-test finite element analysis of this region. Results of the analysis, visual observations, and thickness measurements all indicate that the 22-inch tear initiated due to high strains near a stud anchor. The results of the analysis also suggest that a relatively simple analytical technique can be used to estimate the pressure at which tears will initiate near penetrations in lined containment structures made of reinforced concrete.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 36420, 36437

36323 **(CONF-861185—14) RERTR [Reduced Enrichment Research and Test Reactor] Program fuel development and testing: The past year and the next.** Snelgrove, J.L. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010036/JAW.

From Reduced Enrichment for Research and Test Reactors (RERTR) program international meeting; Gatlinburg, TN, USA (3 Nov 1986).

Testing and demonstration of reduced-enrichment fuels under the US RERTR Program progressed steadily during the past year. The irradiation and examination of highly loaded miniature fuel plates continued in order to establish performance limits and to search for a more fundamental understanding of the swelling mechanism in aluminum-matrix dispersion fuels. Postirradiation examinations of the full-sized elements irradiated in the ORR have been completed, and the whole-core demonstration of U_3Si_2 fuel elements in the ORR is well underway. The current status of the fuel development and testing effort, the significant results obtained during the past year, and the plans for next year are summarized.

36324 **(FEI—1853) Mathematical simulation of stressed-deformed state in rod cylindrical fuel elemnts KONDOR program.** Khmelevskij, M.Ya.; Malakhova, E.I.; Dolmatov, P.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701970/JAW.

A mathematical model for numerical computation of stressed-deformed stae in a rod cylindrical fuel element is developed. The model is based on preliminary discretization of the design scheme and linearization of radial parameters as radius functions. The formulation generality enables to calculate strength parameter kinetics in any circular cylindrical fuel element (e.g. annular fuel element; solid or tubular core; ceramic, metallic or dispersion fuel) for arbitrary transient operating conditions and taking into account all possible loading factors. The method is realized in the KONDOR programm (FORTRAN, ES-1061 computer). An example illustrating computation of stress kinetics in a fast reactor fuel element during transient operation is given. 2 refs.; 3 figs.

2204 Control Systems

REFER ALSO TO CITATION(S) 36434

36325 **(ANL/TM—422(Rev.1)) Guide to telecommunications at ANL.** Winkler, L.; Opitz, L.C.; Heiberger, A.A. (eds.). (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31109-ENG-38. 61p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010341/JAW.

The goals of this manual are to give personnel at Argonne National Laboratory an overview of available telecommunications facilities and services, to promote and encourage the use of Computing Services resources and facilities, and to describe policies and procedures that are part of the decision-making process involved in fulfilling communications requirements. This manual will be the primary source of information on telecommunications.

36326 **(CONF-880506—10) Demonstration of EBR-II power maneuvers without control rod movement.** Chang, L.K.; Mohr, D.; Planchon, H.P.; Feldman, E.E.; Messick, N.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010011/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

A group of five plant inherent control tests was successfully conducted in November 1987 in the Experimental Breeder Reactor II. These tests demonstrated that the plant power of a metal-fueled reactor can be passively controlled over a large power range by slowly changing the primary flow and the reactor inlet temperature. These variables are, in turn, regulated by the primary pump speed, the secondary flow, and the turbine inlet pressure. In all tests, control rods were not used to regulate power. It was demonstrated that the plant power can be controlled with reasonable accuracy without using control rods when the reactivity feedback characteristics of the reactor are well understood and the plant controllers are adequately designed.

36327 **(CONF-880506—19) Ex-vessel water-level and fission-product monitoring for LWR.** DeVolpi, A.; Markoff, D. (Argonne National Lab., IL (USA); Washington Univ., Seattle (USA). Dept. of Physics). 1988. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011999/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

Given that the need for direct measurement of reactor coolant inventory under operational or abnormal conditions remains unsatisfied, a high-energy gamma-ray detection system is described for ex-vessel monitoring. The system has been modeled to predict response in a PWR, and the model has been validated with a LOFT LOCA sequence. The apparatus, situated outside the pressure vessel, would give relative water level and density over the entire vessel height and distinguish differing levels in the downcomer and core. It would also have significant sensitivity after power shutdown because of high-energy gamma rays from photoneutron capture, the photoneutrons being the result of fission-product decay in the core. Fission-products released to the coolant and accumulated in the top of a PWR vessel would also be theoretically detectable.

36328 **(CONF-8806146—2) Application of AI technology to nuclear plant operations.** Sackett, J.I. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012048/JAW.

From American Society for Engineering Education annual conference; Portland, OR, USA (21 Jun 1988).

In this paper, applications of Artificial Intelligence (AI) Technology to nuclear-power plant operation are reviewed. AI Technology is advancing rapidly and in the next five years is expected to enjoy widespread application to operation, maintenance, management and safety. Near term emphasis on a sensor validation, scheduling, alarm handling, and expert systems for procedural assistance. Ultimate applications are envisioned to culminate in autonomous control such as would be necessary for a power system in space, where automatic control actions are taken based upon reasoned conclusions regarding plant conditions, capability and control objectives.

36329 **(EPRI-NP—5719-Vol.3) Reactor emergency action level monitor expert-system prototype: Independent review, Volume 3: Final report.** Groundwater, E.H.; Blanks, M.W. (Electric Power Research Inst., Palo Alto, CA (USA)). Apr 1988. 54p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009221/JAW.

A team from Science Applications International Corporation (SAIC) performed a third-party reveiw of the Reactor Emergency Action Level Monitor System (REALM) expert system developed by Technology Applications, Inc. (TAI) under contract to the

Electric Power Research Institute (EPRI). REALM'S purpose is to monitor power plant sensor data and determine the current Emergency Action Level (EAL), ranging from Normal Operations to General Emergency, each with corresponding reporting requirements required by the Nuclear Regulatory Commission (NRC). The expert system consists of seven sub-experts, having a total of approximately 300 inference rules and 700 objects. This report summarizes the review discussions and SAIC's specific recommendations on the preplanned review topics which surfaced during the review. 13 refs., 1 tab.

36330 **(EPRI-NP—5795) Control-room deficiencies, remedial options, and human factors research needs: Final report.** Seminara, J.L. (Electric Power Research Inst., Palo Alto, CA (USA); Seminara (J.L.), Los Altos, CA (USA)). May 1988. 147p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010312/JAW.

The post-TMI nation-wide Detailed Control Room Design Review (DCRDR) program has generated an extensive and unique body of human factors data. This report examined a sample of 25 DCRDR reports to: (1) identify and prioritize categories of human engineering discrepancies (HEDs), (2) identify novel enhancement solutions, and (3) develop candidate research programs for addressing unresolved issues. A total of 4,335 HEDs were examined and assigned to categories based on NUREG-0700 topical headings. The significance level of HEDs and associated resolution plans reported were also tabulated. This analysis yielded such data as: historical trends in reporting and resolving HEDs; effect of control room review methodology on number of HEDs reported; the relative importance of HEDs in different categories based on significance assessments at 25 plants; the distribution of specific problem areas across 25 plants. Based on a critical review of human factors problem areas and the available guidance for solving these problems, it was possible to develop a series of specific topic and generic issue research candidates. A total of 28 research candidates were developed and ranked in order of importance.

36331 **(EPRI-NP—5835M) FATIGUEPRO: On-line fatigue usage transient monitoring system: Final report.** Riccardella, P.C.; Kuo, A.Y.; Tang, S.S.; Gustin, H.L. (Electric Power Research Inst., Palo Alto, CA (USA); Structural Integrity Associates, San Jose, CA (USA)). May 1988. 79p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011000/JAW.

The objective of this research project was to develop a simplified method for evaluating fatigue usage accumulation at critical nuclear plant locations using existing instrumentation and available plant operating data. The resulting methodology permits cumulative fatigue usage to be monitored and tracked based on actual plant operating cycles rather than by counting cycles for a pre-determined set of design transients. Accomplishment of this objective has involved innovations in a number of key areas, including: (1) development of an analytical methodology to convert existing plant operating data into peak stress versus time at selected critical plant locations; (2) incorporation of the methodology into a computer software program that can be used to automatically compute and record fatigue usage accumulation on-line and in real time while the plant is running; and (3) demonstration of the methodology and software through application to one or more real plant locations for extended field testing. The methodology has been implemented in a software system called FatiguePro. A prototype system has been installed and tested for a limited number of locations at the San Onofre 2 pressurized water reactor (PWR). The results of this pilot plant study have demonstrated the feasibility of such an on-line fatigue usage transient monitoring system.

36332 (IAEA-TECDOC—444, pp 57-65) **Plant data monitoring system for the Angra-I nuclear power plant.** Otton Martins, C. (FURNAS, Rio de Janeiro (Brazil)). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

As a consequence of the post-TMI recommendations, a new Plant Data Monitoring System is being developed in Brazil for the Angra-I nuclear power plant. The main purpose of the system is to monitor the important safety parameters of the plant in a concise manner. In addition, the system includes an environment control system which will be used in emergency situations with a possible radioactivity release. In the present paper the technical details and the capabilities of the system are described and the procedure for implementation and integration of the new system into the existing control room concept is outlined. (author). 7 figs.

36333 (IAEA-TECDOC—444, pp 67-68) **Nuclear power plant operator aids. Summary of activities in the Nordic Countries.** Wahlstroem, B. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

The research and development activities of the Nordic Countries in the area of operator aids and related fields are summarized. Specific Finnish projects in the context are mentioned. (author). 1 ref.

36334 (IAEA-TECDOC—444, pp 69-73) **Computer based control room design for the French 1400 MW nuclear power plants.** Huchet, A. (Electricite de France, 01 - Loyettes. Centrale de Bugey). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

EDF has decided to introduce a new, fully computerized control room design for the future 1400 MW nuclear power plants. In the present paper the new control room concept is described and the time schedule for validation and implementation is outlined. (author). 4 figs.

36335 (IAEA-TECDOC—444, pp 75-93) **Operator aids in nuclear power plants in the Federal Republic of Germany.** Meyer, J. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

The development of Operator Aids in the FRG was based on an integrated approach and in accordance with basic design principles. First, criteria defining the extent of automatic control of the plant are outlined. These criteria consider optimal conditions for the operators, plant availability and plant safety. Second, the actual design of the control room including human engineering principles regarding design and environmental conditions is described. Third, details of the information system itself and the respective hardware are given. (author). 12 figs.

36336 (IAEA-TECDOC—444, pp 95-100) **STAR-GENERIS: A software concept for advanced information presentation of future operator aids.** Felkel, L.; Schueller, H. (Gesellschaft fuer Reaktorsicherheit m.b.H., Garching (Germany, F.R.)). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

Man-machine communication in power plants is increasingly relying on improved information quality provided by computerized operator support systems. It could be demonstrated that the different plant functions can be represented by one advanced software programme package, the STAR-GENERIS. The specific applications now under development include: symptom-oriented display of disturbed plant situation, post-trip analysis, integrated disturbance analysis, alarm reduction, and status surveillance of components and plant systems. (author). 2 figs.

36337 (IAEA-TECDOC—444, pp 101-108) **Computerized operator aids at the PAKS nuclear power plant.** Vamos, G. (Paksi Atomeroemue Vallalat (Hungary)). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

Several operator aids have been installed or are planned at the Paks Nuclear Power Plant in Hungary. The VERONA core monitoring system has been added to the standard process-computer system to analyze and interpret the measurements of the core and the primary loops. Three different Safety Parameter Display Sytems have been tested and are partly in trial operation. A Computerized Tracking of Automatic Functions is in the design phase, as is the Computerization of the Operation Manual. (author). 3 refs, 5 figs.

36338 (IAEA-TECDOC—444, pp 109-137) **ENEL experience in computerized operator aids and human factor activities for control rooms in Italian nuclear power plants which are operating or under construction.** Zanuzzi, G. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

After the TMI accident application of the most important post-TMI-concepts such as the man-machine-interface has been carried out in Italy for the two nuclear power plants Caorso (BWR, MK II) and Alto Lazio (BWR, MK III). For Caorso this includes the improvement of the control room according to NUREG-0700, the introduction of computerized systems such as the 3D MONICORE for core monitoring and management and the SPDS (under evaluation), and the implementation of new symptom-oriented emergency procedures. For Alto Lazio the following activities were carried out: a complete redesign of the control room according to NUREG-0700 concepts, a Technical Support Center (TSC) and Emergency Operating Facilities (EOF), the upgrading of the computer based supervisory system to support operation during emergency conditions and to increase operator efficiency, the design of the operator interface according to Human Factors criteria, and the implementation of new symptom-oriented emergency procedures. Finally a brief description of the main solutions adopted in the man-machine interface and human factor areas for both plants is given.

36339 (IAEA-TECDOC—444, pp 139-150) **Experience in the development of nuclear safety parameter monitoring system for Korean nuclear power plants.** Moon, B.S.; Kim, J.H. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

In this paper, we present the experiences the authors had during the course of carrying out the project 'Development of Nuclear Safety Parameter Monitoring System' for the Korean Ministry of Science and Technology. The current status of the Korean ERF/SPDS project for the Kori four unit system is discussed in this paper. The direction of localization for the ERF/SPDS software and for the related hardware is projected. (author). 5 refs, 4 figs, 1 tab.

36340 (IAEA-TECDOC—444, pp 151-158) **New systems for presentation of process information for the nuclear power station at Borssele (Project 2PR).** Kroon, J.P. (Provinciale Zeeuwse Energie-Maatschappij (PZEM) N.V., Middelburg (Netherlands)). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

Retrofitting computerized operator support systems into an existing control room is described. The application of this new process presentation system includes: Process Data Presentation, Alarm Handling, Monitoring, Calculation and Evaluation of Operating History. Installation is envisaged for the beginning of 1988. (author). 6 figs.

36341 (IAEA-TECDOC—444, pp 159-164) **Status of operator aids in Spain.** Conde, J.M. (Consejo de Seguridad Nuclear, Madrid (Spain)). Dec 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701820/JAW. (CONF-8610402—).

From Technical committee meeting on improving nuclear power plant safety through operator aids; Vienna, Austria (27 Oct 1986).

There are eight NPPs in operation in Spain. Five of them are Westinghouse PWR design with different power capabilities, while two are General Electric BWR design also with different power output. The last one is a Gas Cooled Reactor from a French supplier. The diversity will be increased next year, when a PWR plant of KWU design is due to start operation. This wide variety of plants with different designs increases the effort needed on the part of the regulatory body to address generic safety issues. One of these safety issues is the need for Operator Aids (OA) to improve plant safety through operational performance improvement. This paper outlines briefly the general ideas developed by the Nuclear Safety Council (Consejo de Seguridad Nuclear = CSN) to address this subject; they are presented in paragraph 2. Paragraph 3 describes the OA implementation process, while paragraph 4 is devoted to the actual situation of the OA subject for each plant (operational and under construction).

36342 **(PINSTECH—109) Renovation of PARR instrumentation and controls.** Karim, A.; Haq, I.; Akhtar, K.M.; Alam, G.D. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Engineering Div.). Jan 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702477/JAW.

The Pakistan research reactor (PARR) was commissioned in 1965 and operated since then in accordance with the requirements. In the first instance, it was proposed that the controls and instrumentation be modernized according to the state of current technology and for meeting the more stringent safety, and operational needs. A computer has been added for data acquisition, logging and analysis. A closed circuit television system has been installed to monitor access of personnel to the reactor building and for viewing the reactor core with an underwater camera. This report gives a brief account of the old instrumentation and some details of the new replacements. (orig./A.B). 17 fig.

36343 **Nuclear reactor shutdown control rod assembly.** Bilibin, K. (to Dept. of Energy, Washington, DC). US Patent 4,734,252. 29 Mar 1988. Filed date 7 Aug 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a nuclear reactor having a reactor core and a reactor coolant flowing therethrough, a temperature responsive, self-actuated nuclear reactor shutdown control rod assembly, comprising: an upper drive line terminating at its lower end with a substantially cylindrical wall member having inner and outer surfaces; a lower drive line having a lower end adapted to be attached to a neutron absorber; a ring movable disposed about the outer surface of the wall member of the upper drive line; thermal actuation means adapted to be in heat exchange relationship with coolant in an associated reactor core and in contact with the ring, and balls located within the openings in the upper drive line. When reactor coolant approaches a predetermined design temperature the actuation means moves the ring sufficiently so that the balls move radially out from the recess and into the space formed by the second portion of the ring thereby removing the vertical support for the lower drive line such that the lower drive line moves downwardly and inserts an associated neutron absorber into an associated reactor core resulting in automatic reduction of reactor power.

36344 Programming for a nuclear reactor instrument simulation. Cohn, C. *Simulation;* 50: No. 1, 25-27(Jan 1988).

This note discusses 8086/8087 machine-language programming for simulation of nuclear reactor instrument current inputs by means of a digital-analog converter (DAC) feeding a bank of series input resistors. It also shows FORTRAN programming for generating the parameter tales used in the simulation. These techniques would be generally useful for high-speed simulation of quantities varying over many orders of magnitude.

36345 Techniques for examination and metallurgical damage assessment of pressure vessels. Jaske, C.E. (Battelle's Columbus Div., Columbus, OH (US)). pp 103-110 of Performance and evaluation of light water reactor pressure vessels. Rungta, R.; Gilman, J.D.; Bamford, W.H. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870636—).

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

Metallurgical techniques are used to examine and assess the damage or degradation that occurs in nuclear power plant reactor pressure vessels during long-term service. Those techniques are used to quantify the amount of radiation embrittlement, thermal fatigue cracking, and corrosion fatigue cracking. Those damage mechanisms and the current techniques of surveillance testing and nondestructive inspection used to assess them are reviewed briefly. Emerging damage assessment techniques that may find future use are discussed in more detail. The potential application of the following six emerging techniques is addressed: (1) miniature specimen testing, (2) reconstituted specimen testing, (3) nondestructive measurement of material properties, (4) acoustic emission monitoring, (5) surface replication, and (6) electrochemical testing.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 35733, 36262, 36374, 36385, 36390, 36433

36346 (DP-MS—87-143) Preliminary risks associated with postulated tritium release from production reactor operation. O'Kula, K.R.; Horton, W.H. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 9p. (CONF-880505—15). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009307/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The Probabilistic Risk Assessment (PRA) of Savannah River Plant (SRP) reactor operation is assessing the off-site risk due to tritium releases during postulated full or partial loss of heavy water moderator accidents. Other sources of tritium in the reactor are less likely to contribute to off-site risk in non-fuel melting accident scenarios. Preliminary determination of the frequency of average partial moderator loss (including incidents with leaks as small as .5 kg) yields an estimate of {approximately}1 per reactor year. The full moderator loss frequency is conservatively chosen as 5 {times} 10/sup {minus/3} per reactor year. Conditional consequences, determined with a version of the MACCS code modified to handle tritium, are found to be insignificant. The 95th percentile individual cancer risk is 4 {times} 10/sup {minus/8} per reactor year within 16 km of the release point. The full moderator loss accident contributes about 75% of the evaluated risks. 13 refs., 4 figs., 5 tabs.

36347 (EGG/10282—1138) An aerial radiological survey of the Trojan Nuclear Plant and surrounding area, Prescott, Oregon: Date of survey: July--August 1986. Dahlstrom, T.S. (EG and G Energy Measurements, Inc., Las Vegas, NV (USA)). Feb 1988. Contract AC08-83NV10282. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011668/JAW.

An aerial radiological survey was conducted during the period 24 July through 2 August 1986 over a 124-square-kilometer (48-square-mile) area surrounding the Trojan Nuclear Plant located on the Columbia River at Prescott, Oregon. The survey was conducted at a nominal altitude of 46 meters (150 feet) with line spacings of 76 meters (250 feet). Count rates were converted to exposure rates at 1 meter above the ground. A contour map of the terrestrial gamma exposure rate was prepared and overlaid on a USGS topographic map of the area. The exposure rates varied from 8 to 10 microroentgens per hour (μRh) in the southern and northernmost regions of the survey area with somewhat lesser rates of 6.5 to 8.0 μRh in the immediate vicinity of LongviewKelso, Washington. The highest area of increased activity was directly attributed to the main units of the plant and indicated the presence of ^{60}Co and ^{58}Co. Soil samples and ion chamber measurements were obtained at four locations to support the aerial data. An additional 11 soil samples were collected along the shoreline of the Columbia River. 6 refs., 11 figs., 4 tabs.

36348 (INIS-mf—11153, pp 29-35) **3. Siting of nuclear power plants.** Navratil, J. 1987. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780081/JAW.

In Nuclear power. CAEC lecturers' manual.

The area for nuclear power plant siting in the CSSR is defined by the Federal Ministry of Fuels and Power according to the planned distribution of needs and sources of electric power and heat supply. The preliminary siting is the responsibility of state regional planning institutes TERPLAN and URBION. The investment intent study is made by Energoprojekt, a design organization, assisted by other specialized organizations. The study then serves as the information source for Czechoslovak-Soviet expertise which confirms the feasibility and acceptability of the construction and operation of a nuclear power plant in the given locality. A final decision on the nuclear power plant site is made by the Presidium of the Federal Government. General criteria are discussed used in site selection, including technical feasibility of construction, environmental protection including nuclear safety, minimization of disturbance of other interests in the use of the territory, and economy. In addition to the nuclear power plants under construction, four more areas are considered for the implementation of the Czechoslovak nuclear program till the year 2000, viz., northern Moravia, eastern Bohemia, northern Bohemia and Prague. (Z.M.).

36349 (INIS-mf—11153, pp 55-68) **7. Environmental impact of nuclear power plants.** Singer, J. 1987. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780081/JAW.

In Nuclear power. CAEC lecturers' manual.

The environmental impact is compared of nuclear power plants and of coal-firing plants. The effect on the biosphere is discussed of the construction and operation of nuclear power plants. The irradiation risk associated with nuclear power plants, ionizing radiation sources, radiation protection methods, etc. are characterized with respect to specific radiation effects. Described in more detail are radionuclide migration from the nuclear power plant to surface water, in surface water to aquatic biocenosis, and the radioisotope transport chains atmosphere-man and surface and ground waters-man. Of non-radiation environmental impact of nuclear power plants, attention is devoted to the thermal burden to the environs of the plants, chemical pollution of the environs and the effect of high-voltage transmission lines. (Z.M.).

36350 (INIS-mf—11200) Location sites for nuclear power plants and the public drinking water supplies. An investigation of the possible effects of a nuclear meltdown accident on the public drinking water supply which depends on surface waters as basic element. (Samenwerkende Rijn- en Maaswaterleidingbedrijven (RIWA), Amsterdam (Netherlands). Werkgroep Kerncentrales). May 1987. 25p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702377/JAW.

This report presents the results of a study by the Dutch RIWA- Working Group Nuclear Power Plants, of the possible effects of a nuclear-reactor melt-down accident upon the drinking-water supply in the Netherlands which is dependent on surface waters. The aim of this report is to contribute to the 're-consideration with regard to siting of nuclear power plants' of the Dutch government. In the case of a nuclear-reactor melt-down accident in the Netherlands or directly adjacent countries, surface waters destined for drinking-water production may be contaminated severely. The amount of contamination depends, among other things, upon the distance, wind direction, dry as well as wet deposition and the

features of the place yielding drinking water. From calculations of contamination of surface waters in the case of open- supply build up it appears that the derived norm of the radionuclide cocktail may be exceeded for a period of weeks up to several months or even years. There are reasons to draw the same conclusion for supply build up in the dunes by means of surface infiltration in the dunes. A melt-down accident can cause very severe contamination. Also here it can be stated that, in the case of a calamity in the Netherlands or directly adjacent countries, a norm transgression may occur for weeks up to years. In view of the risks which nuclear power plants can hold for the drinking-water supply which depends upon surface-waters as basis element. Severe objections should be made with respect to the siting of nuclear power plants in the Netherlands unless the occurrence of melt-down accidents could be excluded. 11 refs.; 4 figs.; 7 tabs.

36351 (INIS-mf—11203) **Radiating water. Effects of nuclear power on the drinking water supply.** Bakker, J.; Harle, N.; Heijkers, H.; Schoene, S. (eds.). (Vereniging Milieudefensie, Amsterdam (Netherlands)). Apr 1987. 154p. (In Dutch). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702380/JAW.

From a nuclear power plant in operation radioactivity is continuously effusing into the environment, through the chimney, cooling waters and the loss of solid waste. In this account attention is concentrated on tritium which enters, in the form of gas and tritiated water from nuclear power plants under 'normal' operation, the aquatic environment and which, because it can not be purified from the water and because its effluences in surface waters are larger than those of other radioactive waste products, forms the largest threat for the drinking-water supply. In ch. 1 the health risks of tritium are outlined. In particular the genetic risks are insufficiently known until now. In ch. 2 the amount of tritium effluences are estimated, which appears to be many times higher than was generally accepted until now. What does this imply for the Dutch surface waters? In ch. 3 the question of the source term is discussed and in ch. 4 the source term is translated into the effects upon the aquatic environment and especially upon the drinking-water supply. In ch. 5 advisements for policies are formulated. The policy of the Dutch government until now is viewed and nuclear power is judged on the base of three starting points of radiation policy. Therein the demands are included which are inevitable in order to protect the Dutch aquatic environment from a too large radioactivity burden. 91 refs.; 5 figs.; 1 table.

36352 (INIS-mf—11222, pp 33-34) **Modification of regulations for performing geophysical and engineering seismological surveys during pre-project and project preparation of nuclear power plants.** Cidlinsky, K.; Simunek, P. (Geofyzika, n.p., Brno (Czechoslovakia); Energoprojekt, Prague (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The association of the socialist countries for the development of nuclear power Interatomehnergo has drawn up regulations and guidelines for engineering seismological surveys for pre-project and project preparation of nuclear power plants. The draft national regulations of the USSR, GDR and CSSR are to be unified and approved shortly. A list is given of the criteria which condition the siting of a nuclear power plant in a certain locality, emphasising the range and significance of geological and engineering seismological surveying in the given locality. (Z.M.). 70 figs., 25 tabs., 139 refs.

36353 (INIS-mf—11222, pp 35-36) **Geophysical survey of the site of the North Moravian nuclear power plant.** Cidlinsky, K.; Firbas, P.; Nehybka, V.; Smerdova, J. (Geofyzika, n.p., Brno (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

A brief characteristic is presented of the results of the geophysical survey of the Blahutovice nuclear power plant site in North Moravia, CSSR. Next to seismic methods the geophysical survey also used detailed gravimetric and geoelectric methods; for the first time in Czechoslovakia the method of detailed seismic zoning. For the said measurement a network was installed in 1983 of five sites, one on the considered site of the nuclear power plant, the others along a perimeter with a radius of roughly 12 km. The results of the geophysical survey have shown that the Blahutovice locality is on a compact block where no geophysical or geological anomalies have been recorded. (Z.M.).

36354 (INIS-mf—11222, pp 37-45) **Medium transfer functions for the site of North Moravian nuclear power plant.** Bartak, H. (Energoprojekt, Prague (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The method of seismic zoning was used in the geological survey of the Blahutovice nuclear power plant site in North Moravia (CS). As against the original Soviet method, the method used was broadenend to include the detection of the so-called transfer function of the medium which characterizes the ability of the environment to strengthen or weaken seismic waves. Briefly described are numerical methods which served to determine the impact of certain physical parameters on the character of the transfer function of the environment in the Blahutovice site and some results of calculations are presented. The impact of the following factors is given: the velocity of the propagation of waves in the layer of Quaternary sediments, the velocity of the propagation of seismic waves in the layer of Neogene sediments and the impact of the presence of the Quaternary layer. The calculations were made using the MICRO program. Experimental methods will be used for measuring the reliability of the said calculations of the transfer function of the medium. (Z.M.). 8 figs., 2 tabs., 4 refs.

36355 (NRPB-R—211) **Radiological impact of routine discharges during 1970-1984 and estimated discharges up to 1989 from the UK civil nuclear power programme.** Lawson, G.; McColl, N.; Jones, J.A.; Williams, J.; Dionian, J.; Cooper, J.R. (National Radiological Protection Board, Chilton (UK)). Jan 1988. 104p. H.M. Stationery Office, price Pound 7.00.

This report provides information about the radiological impact on the population of Europe of routine liquid and atmospheric discharges from civil nuclear sites in the United Kingdom. Discharges occurring in the years 1970 to 1984 are used, together with NRPB estimates of discharges from 1985 to 1989. At the time of calculation, 1984 was the most recent year for which complete discharge data for the United Kingdom were published. Collective effective dose equivalent commitments to the population of Europe arising from each year's discharges are calculated. These are presented together with the collective effective dose equivalent commitments truncated at 500 years. More detailed information is given for discharges in 1975 and estimated discharges in 1989, including an estimate of the radiological impact on the population of the United Kingdom.

36356 (NUREG—1273) **Technical findings and regulatory analysis for Generic Safety Issue II.E.4.3, "Containment Integrity Check".** Serkiz, A.W. (Nuclear Regulatory Commission, Washington, DC (USA)). Apr 1988. 165p. NTIS, PC A08/MF A01;1. Order Number TI88008757/JAW.

This report contains the technical findings and regulatory analysis for Generic Safety Issue II.E.4.3, "Containment Integrity Check." An evaluation of the containment isolation history from 1965 to 1983 reveals that (except for a small number of events) containment integrity has been maintained and that the majority of reported events have been events related to exceeding Technical Specification limits (or 0.6 of the allowable leakage level). In addition, more recent risk analyses have shown that allowable leakage rates even if increased by a factor of 10 would not significantly increase risk. Potential methods of continuous monitoring are identified and evaluated. Therefore, these technical findings and risk evaluations support closure of Generic Safety Issue II.E.4.3.

36357 (PINSTECH/HPD—130) Area and environmental gamma dose monitoring at PINSTECH. Javed, M.; Awan, M.A.; Ahmad, S.; Afsar, M.; Orfi, S.D. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Health Physics Div.). Nov 1986. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702478/JAW.

Radiation dose monitoring of various radioactive laboratories including PARR building, radioactive waste disposal area and the environment upto initial peripheral limits of PINSTECH has been carried out by TLD's installed at different locations. Average dose rates in terms of percentage of dose limits have been compiled. The results for the year 1985 have been discussed in this report.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 36342, 36378, 36381, 36416, 36434, 37557

36358 (CEA-CONF—9118) Horizontal beams creation on a mean power reactor: Isis 700 kW. Morin, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Aug 1987. 17p. (In French). (CONF-871004—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753451/JAW.

From International conference on the utilization of multipurpose research reactors and related international co-operation; Grenoble, France (19 Oct 1987).

To satisfy the requests of experimenters, two horizontal beams, tangential at core, have been created. After a brief recall of the Isis reactor the author describes the realized works and gives a summary description of the two beams equipment.

36359 (CONF-880422—1) Software engineering for the EBR-II data acquisition system conversion. Schorzman, W. (Argonne National Lab., Idaho Falls, ID (USA)). 1988. Contract W-31109-ENG-38. 20p. (CONF-880422—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009950/JAW.

From Topical meeting on engineering for nuclear plant operation and maintenance; Myrtle Beach, SC, USA (17 Apr 1988).

The purpose of this paper is to outline how EBR-II engineering approached the data acquisition system (DAS) software conversion project with the restraints of operational transparency and six weeks for final implementation and testing. Software engineering is a relatively new discipline that provides a structured philosopy for software conversion. The software life cycle is structured into six basic steps: 1) initiation, 2) requirements definition, 3) design, 4) programming, 5) testing, and 6) operations. These steps are loosely defined and can be altered to fit specific software applications. DAS software is encompassed from three sources: 1) custom software, 2) system software, and 3) in-house application software. A data flow structure is used to describe the DAS software. The categories are: 1) software used to bring signals into the central processer, 2) software that transforms the analog data to engineering units and then logs the data in the data store, and 3) software used to transport and display the data. The focus of this paper is to describe how the conversion team used a structured engineering approach and utilized the resources available to produce a quality system on time. Although successful, the conversion process provided some pit falls and stumbling blocks. Working through these obstacles enhanced our understanding and surfaced in the form of LESSONS LEARNED, which are gracefully shared in this paper.

36360 (CONF-8804126—1) Neutron flux enhancement in the NRAD reactor. Weeks, A.A.; Heidel, C.C.; Imel, G.R. (Argonne National Lab., Idaho Falls, ID (USA)). 1988. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010000/JAW.

From 11. annual TRIGA users conference; Bethesda, MD, USA (10 Apr 1988).

In 1987 a series of experiments were conducted at the NRAD reactor facility at Argonne National Laboratory - West (ANL-W) to investigate the possibility of increasing the thermal neutron content at the end of the reactor's east beam tube through the use of hydrogenous flux traps. It was desired to increase the thermal flux for a series of experiments to be performed in the east radiography cell, in which the enhanced flux was required in a relatively small volume. Hence, it was feasible to attempt to focus the cross section of the beam to a smaller area. Two flux traps were constructed from unborated polypropylene and tested to determine their effectiveness. Both traps were open to the entire cross-sectional area of the neutron beam (as it emerges from the wall and enters the beam room). The sides then converged such that at the end of the trap the beam would be 'focused' to a greater intensity. The differences in the two flux traps were primarily in length, and hence angle to the beam as the inlet and outlet cross-sectional areas were held constant. It should be noted that merely placing a slab of polypropylene in the beam will not yield significant multiplication as neutrons are primarily scattered away.

36361 (CONF-8806165—1) Small break LOCA analysis of the ONRL high flux isotope reactor. Wilson, T.L. Jr.; Cook, D.H.; Sozer, A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012200/JAW.

From EPRI conference on power plant simulators and modeling; Charlotte, NC, USA (15 Jun 1988).

A digital simulation program, HFIRSYS, was developed using MMS to analyze small break loss of coolant events in the ORNL High Flux Isotope Reactor. The code evaluates the response of the primary reactor system including automatic controls actions resulting from breaks in auxiliary piping connected to the primary. The primary output of the code is the margin to the onset of nucleate boiling expressed as a ratio of heat flux which would cause boiling to the current hot channel heat flux. A description of the model, validation results and a sample transient are presented.

36362 (DOE/ER/02096—T3) University of Arizona TRIGA Reactor: 1986-1987 annual utilization report. Nelson, G.W. (Arizona Univ., Tucson (USA). Dept. of Nuclear and Energy Engineering). 1986. Contract AC07-76ER02096. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007321/JAW.

This is the annual report for the University of Arizona TRIGA Reactor under Contract No. AC02-76ER02096 covering the period July 1, 1986 through June 30, 1987 including the 1986-87 Academic Year. The purpose of this report is to document the facility usage which is possible because of DOE support under the contract. The reactor is operated under License R-52 with the United States Nuclear Regulatory Commission.

36363 (FEI—1735) Automated system for studying irradiation creep of materials in the BR-10 nuclear. Aim and design concept. Kruglov, A.S.; Bykov, V.N.; Chubarov, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701966/JAW.

General concepts of construction aim and structure of the KRIP (complex reactor investigation of creep) scientific research automated system (SRAS) designed for studies in the fields of radiation materials technology carried out in the BR-10 reactor, are considered. A complex of intrachannel test devices providing for stress excitation in materials of samples tested is the central element of the KRIP SRAS. The microprocessor system based on the SM-1800 computer provides for programmed control of the device operation under automatic condition. Development of the KRIP SRAS is a stage on the way of creation of the automated research complex designed for the expansion of the volume of works and decrease of manpower requirements and cost of a definite experiment. 6 refs.; 2 figs.

36364 (ORNL/TM—10444) Evaluation of HFIR [High Flux Isotope Reactor] pressure-vessel integrity considering radiation embrittlement. Cheverton, R.D.; Merkle, J.G.; Nanstad, R.K. (eds.). (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 273p. NTIS, PC A12/MF A01;1; GPO Dep. Order Number DE88008959/JAW.

The High Flux Isotope Reactor (HFIR) pressure vessel has been in service for 20 years, and during this time, radiation damage was monitored with a vessel-material surveillance program. In mid-November 1986, data from this program indicated that the radiation-induced reduction in fracture toughness was greater than expected. As a result, a reevaluation of vessel integrity was undertaken. Updated methods of fracture-mechanics analysis were applied, and an accelerated irradiations program was conducted using the Oak Ridge Research Reactor. Results of these efforts indicate that (1) the vessel life can be extended 10 years if the reactor power level is reduced 15% and if the vessel is subjected to a hydrostatic proof test each year; (2) during the 10-year life extension, significant radiation damage will be limited to a rather small area around the beam tubes; and (3) the greater-than-expected damage rate is the result of the very low neutron flux in the HFIR vessel relative to that in samples of material irradiated in materials-testing reactors (a factor of $\sim 10^4$ less), that is, a rate effect.

36365 (PINSTECH/NED—128) Effect of different reflector materials on core neutronics of LEU cores of MTR type research reactor. Khan, L.A.; Qazi, M.K. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Engineering Div.). Sep 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702479/JAW.

Effect of different reflector materials like light water, heavy water, graphite, beryllium, and beryllium oxides on core excess reactivity and multigroup neutron fluxes have been studied using standard computer codes WIMS-D and EXTERMINATOR-II. Three energy groups, X-Y calculations have reflected on two opposite faces by single row/double row of the reflector material followed by light water The core reflected by single row of light water, heavy water, graphite, beryllium and beryllium oxide has a percentage excess reactivity of 7.38, 10.03, 9.82, 11.93 and 11.67, respectively. Total excess reactivity of the core becomes 7.38, 10.63, 12.86 and 12.54 percentage respectively, when the second row of the reflector material is introduced.

36366 (PTB-FMRB—112) Filtered neutron beams at the FMRB - review and current status. Alberts, W.G.; Dietz, E. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Forschungs- und Messreaktor). Dec 1987. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753585/JAW.

A review is presented of our experience with filtered neutron beams installed in beam tubes of the Research and Measurement Reactor Braunschweig since 1976: Desing of the filters and measurement of the beam parameters are reported and an outline of the research work done with the beams is given. The present status of the irradiation facility, which consists of 5 beams (144 keV, 24.5 keV, 2 keV, 0.2 keV and thermal neutrons), is described in some detail to allow understanding of the physical as well as the technical prerequisites for performing calibrations of neutron measuring instruments. An appendix contains the actual beam parameters.

36367 (WHC-SA—0144) Fast Flux Test Facility sodium pump operating experience - mechanical. Buonamici, R. (Westinghouse Hanford Co., Richland, WA (USA)). Nov 1987. Contract AC06-87RL10930. 9p. (CONF-871199—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011947/JAW.

From US/UK specialist meeting on sodium pumps; San Jose, CA, USA (9 Nov 1987).

The Heat Transport System (HTS) pumps were designed, fabricated, tested, and installed in the Fast Flux Test Facility (FFTF) Plant during the period from September 1970 through July 1977. Since completion of the installation and sodium fill in December 1978, the FFTF Plant pumps have undergone extensive testing and operation with HTS testing and reactor operation. Steady-state hydraulic and mechanical performances have been and are excellent. In all, FFTF primary and secondary pumps have operated in sodium for approximately 75,000 hours and 79,000 hours, respectively, to August 24, 1987.

36368 Comparisons of PRD components for various EBR-II configurations. Meneghetti, D.; Kucera, D.A. (Argonne National Lab., IL (USA)). *Annals of Nuclear Energy;* **14**: No. 9, 473-480(1987). Contract W-31-109-ENG-38.

Comparison of detailed calculations of contributions by region and component of the power-reactivity-decrements (PRD) for four differing loading configurations of the Experimental Breeder Reactor-II (EBR-II) are given. The linear components and Doppler components are calculated. The non-linear (primarily subassembly bowing) components are deduced by differences relative to measured total PRD values. Variations in linear components range from about 10% to as much as about a factor of two depending upon the component. The deduced non-linear components can differ both in magnitude and sign. Effects of differing assumptions of the nature of the fuel-to-clad interactions upon the PRD components are also calculated.

36369 Time constants and feedback transfer functions of EBR-II subassembly types. Grimm, K.N.; Meneghetti, D. (Argonne National Lab., IL (USA)). *Annals of Nuclear Energy;* **14**: No. 9, 481-487(1987). Contract W-31-109-ENG-38.

Time constants, feedback reactivity transfer functions and power coefficients are calculated for stereotypical subassemblies in the EBR-II reactor. These quantities are calculated from nodal reactivities obtained from a reactor kinetic code analysis for a step change in power. Due to the multiplicity of eigenvalues, there are several time constants for each nodal position in a subassembly. Compared with these calculated values are analytically derived values for the initial node of a given channel.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 36364, 36387, 36402

2209 Reactor Safety

REFER ALSO TO CITATION(S) 35792, 36184, 36267, 36268, 36284, 36285, 36313, 36314, 36317, 36333, 36335, 36339, 36340, 36341, 36343, 36346, 36355, 36356, 37566

36370 (BMU—1986-133) Concept to support the safety assessment in nuclear power plants with probabilistic methods. Status report. Methodology, risk limit line curves and practical applications. Gottschalk, P.A.; Bracht, K.; Fidorra, J.; Friederichs, H.; Gruendler, D.; Hofer, E.; Jahns, A.; Kaestle, H.J.; Krzykacz, B.; Liemersdorf, H. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). 1986. 208p. (In German). (GRS-A—991). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The discussion among experts centers on the question whether risk limits based on probabilistic considerations could be introduced. A great number of different approaches are available worldwide. They concern different subaspects. Unified yardsticks for a comparative evaluation of the total spectrum of events ranging from normal operation to deviations and incidents till hypothetical accidents in nuclear power plants are not available. The book shows a special path to consistent systematics. Methodology and approach are demonstrated under the aspect of the individual risk and for a limitation of the incidence probability for stochastic effects of radiation. Farmer's idea of a limit-line curve as a means for safety assessment is developed further. A risk limit-line curve is made according to Cox and Baybutt's suggestion. The curve delin-

eates delayed-injury-relevant individual doses according to their expected frequency in dependence from the dose level. Numerical data are derived from their pollution control concept of the Radiation Protection Ordinance. The construction of the limit-line curve is described and its possible use for a consistent assignment to dose, frequency and risk classes is shown. The RIGREP computer programme for explicit calculation of the curve and derived variables is presented. Pertinent results from reactor safety research are taken to demonstrate a concept for the evaluation of the risk induced by incident and accident.

36371 **(BNL-NUREG—40365) Severe accident core heatup transients in modular high temperature gas-cooled reactors without operating Reactor Cavity Cooling Systems.** Kroeger, P.G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-880532—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88002093/JAW.

From American Nuclear Society topical meeting; Seattle, WA, USA (1 May 1988).

The ultimate decay heat removal system for the current Modular High Temperature Gas-Cooled reactors is a completely passive natural convection air cooling loop. This paper considers an extremely remote accident scenario, where even this passive system fails, and heat rejection is only via a layer of thermal insulation to the reactor silo structure and the surrounding soil. The results show that even in this case the peak fuel temperatures remain well within safe limits. However, vessel and concrete temperatures can - under extreme circumstances and after several weeks - reach temperature levels at which structural failure becomes possible.

36372 **(CEA-CONF—9263) Experimental validation for calcul methods of structures having shock non-linearity.** Brochard, D.; Buland, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 9p. (In French). (CONF-8711193—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753469/JAW.

From Symposium on non linear behaviour of reinforced concrete submitted to a seismic excitation; Saint-Remy-Les-Chevreuse, France (25 Nov 1987).

For the seismic analysis of non-linear structures, numerical methods have been developed which need to be validated on experimental results. The aim of this paper is to present the design method of a test program which results will be used for this purpose. Some applications to nuclear components will illustrate this presentation.

36373 **(CEA-IPSN-INFO—70) Tricastin 4 shutdown for safety injection circuit repair.** (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Jun 1987. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752563/JAW.

36374 **(CNEA-NT—49/85) Radiation protection criteria for cases of probabilistic disruptive events.** Beninson, D.J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Proteccion Radiologica y Seguridad). 1985. 8p. (In Spanish). (CNEA-REPO—17). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702229/JAW.

The individual risk limitation for the case of probabilistic disruptive events is studied, when the radiation effects cease to be only stochastic; the proposed criterion is applied for the case of high level waste repositories. The protection's optimization results from the differential cost-benefit. More general procedures of decision theory that use probabilistically defined utility functions are considered for its calculation. These more general procedures can be applied also in cases where radiation exposures are only potential, to optimize the required level of safety features. It is shown that for disruptive events of low probability and large resulting consequences, the concept of 'expectation' of consequence can not be used in decision making, but that the use of probabilistically based utility functions can conceptually assure a consistent approach in deciding the required level of safety. The use of utility functions of logaritmic form to assign weights to consequences involving different loss of life is explored (M.E.L.).

36375 **(CONF-880455—3) Simulating unprotected accidents for advanced liquid metal reactors using the SAS4A accident analysis code.** Tentner, A.M.; Dunn, F.E.; Kalimullah; Miles, K.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 9p. NTIS, PC A02;3. Order Number DE88009934/JAW.

From Conference of the Society of Computer Simulation; Orlando, FL, USA (18 Apr 1988).

To ensure that the public health and safety are protected during any accident in a Liquid Metal Fast Breeder Reactor (LMFBR), many accidents are analyzed for their potential consequences. The SAS4A code system, described in this paper, provides such an analysis capabililty, including the ability to analyze low probability events such as the Hypothetical Core Disruptive Accidents (HCDAs). The SAS4A code system has been designed to simulate the events that occur in a LMFBR core during the initiating phase of a Hypothetical Core Core Disruptive Accident. During such postulated accident scenarios as the Loss-of-Flow and Transient Overpower events, a large number of interrelated physical phenomena occur during a relatively short time. These phenomena include transient heat transfer and hydrodynamic events, coolant boiling and fuel and cladding melting and relocaton. Due to the strong neutronic feedback present in a nuclear reactor, these events can significantly influence the reactor power. The SAS4A code system is used in the safety analysis of nuclear reactors, in order to estimate the energetic potential of very low probability accidents. The results of SAS4A simulations are also used by reactor designers in order to build safer reactors and eliminate the possibility of any accident which could endanger the public safety.

36376 **(CONF-880506—3) Probabilities of inherent shutdown of unprotected events in innovative liquid metal reactors.** Mueller, C.J.; Wade, D.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009946/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

The uncertainty in predicting the effectiveness of inherent shutdown in innovative liquid metal cooled reactors with metallic fuel results from three broad contributing areas of uncertainty: (1) the inability to exactly predict the frequency of ATWS events with potential to challenge the safety systems and require inherent shutdown; (2) the approximation of representing all such events by a selected set of "generic scenarios"; and (3) the inability to exactly calculate the core response to the selected generic scenarios. This paper discusses the work being done to address each of these contributing areas, identifies the design and research approaches being used at Argonne National Laboratory to reducing the key contributions to uncertainties in inherent shutdown, and presents results. The conditional probabilities (given ATWS initiation) of achieving temperatures capable of defeating inherent shutdown are shown to range from {approximately}0.1% to negligible for current designs.

36377 **(CONF-880506—8) The US Liquid Metal Reactor Development Program.** Till, C.E.; Arnold, W.H.; Griffith, J.D. (Argonne National Lab., IL (USA); Westinghouse Hanford Co., Richland, WA (USA); USDOE Assistant Secretary for Nuclear Energy, Washington, DC). 1988. Contract W-31109-ENG-38. 7p. (CONF-880506—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009951/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

The US Liquid Metal Reactor Development Program has been restructured to take advantage of the opportunity today to carry out R and D on truly advanced reactor technology. The program gives particular emphasis to improvements to reactor safety. The new directions are based on the technology of the Integral Fast Reactor (IFR). Much of the basis for superior safety performance using IFR technology has been experimentally verified and aggressive programs continue in EBR-II and TREAT. Progress has been made in demonstrating both the metallic fuel and the new

electrochemical processes of the IFR. The FFTF facility is converting to metallic fuel; however, FFTF also maintains a considerable US program in oxide fuels. In addition, generic programs are continuing in steam generator testing, materials development, and, with international cooperation, aqueous reprocessing. Design studies are carried out in conjunction with the IFR technology development program. In summary, the US maintains an active development program in Liquid Metal Reactor technology, and new directions in reactor safety are central to the program.

36378 (CONF-880506—12) Integral fast reactor safety features. Cahalan, J.E.; Kramer, J.M.; Marchaterre, J.F.; Mueller, C.J.; Pedersen, D.R.; Sevy, R.H.; Wade, D.C.; Wei, T.Y.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010012/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

The Integral Fast Reactor (IFR) is an advanced liquid-metal-cooled reactor concept being developed at Argonne National Laboratory. The two major goals of the IFR development effort are improved economics and enhanced safety. In addition to liquid metal cooling, the principal design features that distinguish the IFR are: (1) a pool-type primary system, (2) an advanced ternary alloy metallic fuel, and (3) an integral fuel cycle with on-site fuel reprocessing and fabrication. This paper focuses on the technical aspects of the improved safety margins available in the IFR concept. This increased level of safety is made possible by (1) the liquid metal (sodium) coolant and pool-type primary system layout, which together facilitate passive decay heat removal, and (2) a sodium-bonded metallic fuel pin design with thermal and neutronic properties that provide passive core responses which control and mitigate the consequences of reactor accidents.

36379 (CONF-880506—14) Behavior of metallic fuel in treat transient overpower tests. Bauer, T.H.; Wright, A.E.; Robinson, W.R.; Klickman, A.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01. Order Number TI88010042/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

Results and analyses are reported for TREAT in-pile transient overpower tests of margin to cladding failure and pre-failure axial expansion of metallic fuel. In all cases the power rise was exponential on an 8 s period until either incipient or actual cladding failure was achieved. Test fuel included EBR-II driver fuel and ternary alloy, the reference fuel of the Intergral Fast Reactor concept. Test pin burnup spanned the widest range available. The nature of the observed cladding failure and resultant fuel dispersals is described. Simple models are presented which describe observed cladding failures and pre-failure axial expansions yet are general enough to apply to all metal fuel types.

36380 (CONF-880506—15) PRD [power-reactivity-decrement] components of a homogeneous U10Zr-fueled 900 MWt LMR. Meneghetti, D.; Kucera, D.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010039/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

The linear and Doppler feedback components of the regional contributions of the power-reactivity-decrement (PRD) for a representative 900 MWt homogeneous U10Zr-fueled sodium-cooled reactor are calculated. The PRD is the reactivity required to bring the reactor from zero-power hot-critical condition to a given power level. These components are further separated into power dependent and power-to-flow dependent parts. The values are compared with corresponding quantities calculated for the Experimental Breeder Reactor II (EBR-II). The implications of these comparisons upon inherent safety characteristics of metal-fueled sodium-cooled reactors are discussed. The effects of fuel axial restraint on feedback, resulting from possible fuel-clad interactions due to burnup are also calculated. The possible enhancement of desirable feedbacks by use of appropriately designed subassembly-duct bowing feedback characteristics is estimated.

36381 (CONF-880506—17) A risk characterization of safety research areas for Integral Fast Reactor program planning. Mueller, C.J.; Cahalan, J.E.; Hill, D.J.; Kramer, J.M.; Marchaterre, J.F.; Pedersen, D.R.; Sevy, R.H.; Tilbrook, R.W.; Wei, T.Y.; Wright, A.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011199/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

This paper characterizes the areas of Integral Fast Reactor (IFR) safety research in terms of their importance in addressing the risk of core disruption sequences for innovative designs. Such sequences have traditionally been determined to constitute the primary risk to public health and safety. All core disruption sequences are folded into four fault categories: classic unprotected (unscrammed) events; loss of decay heat; local fault propagation; and failure of critical reactor structures. Event trees are used to describe these sequences and the areas in the IFR Safety and related Base Technology research programs are discussed with respect to their relevance in addressing the key issues in preventing or delimiting core disruptive sequences. Thus a measure of potential for risk reduction is obtained for guidance in establishing research priorites.

36382 (CONF-880702—6) Passive safety and the advanced liquid metal reactors. Hill, D.J.; Pedersen, D.R.; Marchaterre, J.F. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 19p. (CONF-880702—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009953/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Advanced Liquid Metal Reactors being developed today in the USA are designed to make maximum use of passive safety features. Much of the LMR safety work at Argonne National Laboratory is concerned with demonstrating, both theoretically and experimentally, the effectiveness of the passive safety features. The characteristics that contribute to passive safety are discussed, with particular emphasis on decay heat removal systems, together with examples of Argonne's theoretical and experimental programs in this area.

36383 (CONF-880748—5) Evaluation of aged concrete structures for continued service in nuclear power plants. Naus, D.J.; Marchbanks, M.F.; Arndt, E.G. (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011832/JAW.

From American Nuclear Society topical meeting on nuclear power plant life extension; Snowbird, UT, USA (31 Jul 1988).

Results are summarized of a study on concrete component aging and its significance relative to continued service of nuclear power plants (NPPs) beyond the initial period for which they were granted operating licenses. Progress is presented of a second study being conducted to identify and provide acceptance criteria for structural safety issues which the USNRC staff will need to address when applications are submitted for continued service of NPPs. Major activities under this program include: development of a materials property data base, establishment of structural component assessment and repair procedures, and development of a methodology for determination of structural reliability.

36384 (CONF-8806153—1) Role of BWR secondary containments in severe accident mitigation: issues and insights from recent analyses. Greene, S.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011837/JAW.

From 4. workshop on containment integrity; Arlington, VA, USA (14 Jun 1988).

All commercial boiling water reactor (BWR) plants in the US employ primary containments of the pressure suppression design. These primary containments are surrounded and enclosed by a secondary containment consisting of a reactor building and refueling bay (MK I and MK II designs), a shield building, auxiliary

building and fuel building (MK III), or an auxiliary building and enclosure building (Grand Gulf style MK III). Although secondary containment designs are highly plant specific, their purpose is to minimize the ground level release of radioactive material for a spectrum of traditional design basis accidents. While not designed for severe accident mitigation, these secondary containments might also reduce the radiological consequences of severe accidents. This issue is receiving increasing attention due to concerns that BWR MK I primary containment integrity would be lost should a significant mass of molten debris escape the reactor vessel during a severe accident. This paper presents a brief overview of domestic BWR secondary containment designs and highlights plant-specific features that could influence secondary containment severe accident survivability and accident mitigation effectiveness. Current issues surrounding secondary containment performance are discussed, and insights gained from recent ORNL secondary containment studies of Browns Ferry, Peach Bottom, and Shoreham are presented. Areas of significant uncertainty are identified and recommendations for future research are presented.

36385 (DBW-RIZA—87-014x) Radioactivity after 'Chernobyl'. Cesium spread in Dutch waters caused by the 'Chernobyl' accident: first results and adapted research program. Hettling, H.K. (Rijkswaterstaat, Lelystad (Netherlands). Dienst Binnenwateren - Rijksinstituut voor de Zuivering van Afvalwater (RIZA)). Jan 1987. 34p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702231/JAW.

In consequence of the reactor accident in Chernobylsk a large number of Dutch waters have been investigated for the occurrence and spread of radionuclides, especially with the intention to know better the effects of long-living radionuclides (Cs-137) on the aquatic environment. For humans Cs-137 is of particular importance because of its long lifetime (30 years) and because it is accumulated predominantly in the muscles, which results in an increment of internal irradiation. These results also can be employed for forecasting the effects and follow-ups of calamities and of effluents from nuclear-power plants. Finally Cs may be used as tracer for studying hydrological processes (mixing-rate in underwater bottom, behaviour of micropollution, sedimentation). Concrete points for attention are horizontal and vertical spread of cesium, the processes and mechanisms which play a role therein and the effects upon the (biotic and abiotic) aquatic environment. The field research carried out for this purpose is subdivided in a monitory program and a process investigation. Because of operational problems until now only the analysis results from May up to July 1986 are available. Besides this field research a literature investigation has been carried out of the environment of Cs-137, the most important long-living radionuclide which efflued from the reactor accident. In this report the results are inventarized of the field research and literature investigation carried out until now. A linking program has been drawn up, based on these results. 14 refs.; 2 figs.; 1 table.

36386 (DOE/NE/37945—T1) Simulation-based expert system for nuclear reactor diagnostics: Final report, September 15, 1985-April 30, 1988. Lee, J.C.; Martin, W.R.; Wehe, D.K. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Apr 1988. Contract AC02-85NE37945. 23p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010182/JAW.

An expert system methodology combining model- and rule-based algorithms has been developed for diagnosis of off-normal events in nuclear power plants. A rule-based reasoning system is used in a fuzzy logic structure to analyze plant data heuristically to form a set of hypotheses about a particular transient. Hypothesis testing and fault magnitude estimation are performed with simulation programs to model plant behavior. A new parameter estimation algorithm, called the simulation filter, has been developed for accurate simulation of plant dynamics with low-order physical models of plant components. A critical safety function approach is used to delineate the complexity of a power plant. The simulation-based expert system methodology has been incorporated as the Rx code. Validity of the Rx methodology has been tested through simulation of the Three Mile Island accident. Methods of systematically generating diagnostic rules through pattern recognition and fault tree encoding have been developed and demonstrated on a preliminary basis.

36387 (DPST—88-469) Reactor materials program process water component failure probability. Daugherty, W. L. (Savannah River Lab., Aiken, SC (USA)). 12 Apr 1988. Contract AC09-76SR00001. 66p. NTIS, PC A04;3. Order Number DE88011676/JAW.

The maximum rate loss of coolant accident for the Savannah River Production Reactors is presently specified as the abrupt double-ended guillotine break (DEGB) of a large process water pipe. This accident is not considered credible in light of the low applied stresses and the inherent ductility of the piping materials. The Reactor Materials Program was initiated to provide the technical basis for an alternate, credible maximum rate LOCA. The major thrust of this program is to develop an alternate worst case accident scenario by deterministic means. In addition, the probability of a DEGB is also being determined; to show that in addition to being mechanistically incredible, it is also highly improbable. The probability of a DEGB of the process water piping is evaluated in two parts: failure by direct means, and indirectly-induced failure. These two areas have been discussed in other reports. In addition, the frequency of a large bread (equivalent to a DEGB) in other process water system components is assessed. This report reviews the large break frequency for each component as well as the overall large break frequency for the reactor system.

36388 (EGG-M—01288) Estimated TMI-2 vessel thermal response based on the lower plenum debris configuration. Tolman, E.L.; Moore, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 30p. (CONF-880724—16). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007705/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

The TMI-2 accident resulted in extensive reactor core damage and release of fission products from the fuel. Recent defueling work has confirmed that 30 to 40% (40 to 55 metric tons) of the orginial core material achieved melting temperatures, and an estimated 15 metric tons of molten core material relocated to the lower head region of the reactor vessel. Because of the extensive core damage and core material relocation, the TMI-2 accident provides a unique opportunity to extend our understanding of the physical processes controlling the latter stages of in-vessel core damage progression. The TMI-2 data have provided important insight into the initial core heatup and relocation mechanisms, interaction of the molten core materials with the core support structures and vessel coolant, and the potential localized damage to the instrument assemblies and vessel head. This paper presents the results of recent analytical work to evaluate the long-term thermal response of the lower head.

36389 (EPRI-NP—4917) Commercial-grade motors in safety-related applications: Final report. Holzman, P.M. (Strategic Technology and Resources, Winchester, MA (USA)). Apr 1988. 160p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010309/JAW.

The objective of this project was to discuss the process necessary to utilize commercial grade equipment in safety related applications and to provide utilities with guidance for accepting commercial grade motors for safety-related applications. The generic commercial-grade concepts presented in this report can be successfully applied to motors. Commercial grade item utilization has the greatest applicability to motors in "mild" environments, because these motors are essentially similar to commercial grade motors in materials, construction methods, and capabilities. The acceptance process is less applicable to motors that are subject to "harsh" environments during postulated accidents, because of the unique design features and testing required to qualify these motors.

36390 (EPRI-NP—5753M) Source Term Experiments Project (STEP): A summary: Final report. Baker, L. Jr.; Fink, J.K.; Simms, R.; Schlenger, B.J.; Herceg, J.E. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 128p. NTIS, PC A07/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. Order Number DE88007532/JAW.

A series of four experiments aimed at characterizing the radiological source term associated with postulated severe light water reactor accidents has been conducted at Argonne National Laboratory's TREAT Facility. The experiments were designed to provide data regarding the physicochemical properties, near the point of origin, of the biologically important volatile fission products released early in such accidents. This report summarizes the conduct and the posttest examination results of the STEP tests, which were simulations of the early phases or risk-dominating accident sequences in both pressurized water reactors and boiling water reactors. The thermal-hydraulic results of the tests, including the hydrogen generated by Zircaloy-steam reaction, were described by code calculations. The calculated maximum fuel temperatures ranged from about 2200 K to 2900 K for the tests. Deposits on coupons from the sample tree, located directly above the four fuel element bundle, and from coupons, deposition plates, and impactor wires, located in canisters adjacent to the test vessel, were examined by scanning electron microscope (SEM), electron microprobe, and other methods. The SEM images were used to determine aerosol size distributions and concentrations. An extensive release of fission products occurred for the low pressure tests, STEP-1 and -2. The relative quantities, morphologies, and chemical characteristics were determined for the released fission products: cesium, iodine, tellurium, molybdenum, and rubidium; and the fuel element materials: tin, zirconium, and uranium. A smaller release of fission products occurred in the high pressure tests, STEP-3 and -4, because of the lower fuel temperatures which resulted from a natural convective flow process induced under the high pressure conditions.

36391 (EPRI-NP—5769-Vol.2) Degradation and failure of bolting in nuclear power plants: Volume 2: Final report. Nickell, R.E. (Applied Science and Technology, Poway, CA (USA)). Apr 1988. 316p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009899/JAW.

A four-year program to resolve the generic safety issue of bolting degradation and failure in nuclear power plants has developed guidelines for material selection, bolting preload control, and plant operation, as well as a realistic method for evaluating the structural integrity of bolted joints. These measures can help improve plant availability while reducing radiation exposure and costs of maintenance and inspection. This report provides the technical basis for resolution of the generic issue of bolting degradation and failure in nuclear power plants.

36392 (EPRI-NP—5777-Vol.1) Defensive strategies for reducing susceptibility to common-cause failures: Volume 1, Defensive strategies: Final report. Crellin, G.L.; Mott, J.E.; Smith, A.M. (Saratoga Engineering Consultants, Inc., San Jose, CA (USA)). Jun 1988. 100p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011429/JAW.

This report presents the final results of EPRI Project RP2169-5. The study, begun in 1982, had three overall objectives: (1) develop a better method for understanding fault events, in general, and common cause failures (CCF) in particular; (2) develop a well focused data base for analyzing factors that describe or influence CCFs; (3) develop and assess defensive measures that might be employed against CCFs. In response to the first objective, a Classification System was developed as a logical and credible method for dissecting and understanding fault events, with special attention on the means to clearly identify and evaluate those events with multiple faults deriving from a common or shared cause. This system, which employs the concept of Linear and Branched Events, is briefly described herein with examples illustrating its use. A data base consisting of over 1700 events was compiled to meet the second objective, and a variety of analyses drawn from that data base are presented. The major portion of the report is devoted to the investigations conducted on defensive measures for CCFs. Analytically-based, data-based and expert-based approach are each discussed in detail, and provide a variety of guidelines that may be used to delineate specific defensive actions for both new plant designs as well as currently operating plants. 17 refs., 25 figs., 1 tab.

36393 (EPRI-NP—5811) Experimental simulation of a small-scale Babcock & Wilcox reactor model: Final report. Kiang, R.L.; Jeuck, P.R. III; Shrader, E.J. (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1988. 196p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010313/JAW.

This report documents the design, the instrumentation system, the data-acquisition system, and the testing of a small-scale, low pressure model of the cooling systems of a Babcock & Wilcox pressurized water reactor. This work is part of a larger program to address some of the safety issues in the B & W design. This test data are stored on data tapes; they are available to qualified requesters through EPRI. The primary use of these data is expected to be code verification and comparisons with results from other test facilities in the program.

36394 (EPRI-NP—5821) TMI-2 technology transfer progress report: Interim report. Owrutsky, S.; Schwartz, F.L. (Electric Power Research Inst., Palo Alto, CA (USA); Pentek, Inc., Coraopolis, PA (USA)). May 1988. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011001/JAW.

The objective of this report is to communicate the scope and key accomplishments of the TM1-2 technology transfer program; to show the relationship of various TM1-2 activities to the overall cleanup effort and to other EPRI-sponsored nuclear power programs.

36395 (EUR—11043) Analysis of the print media in Europe following the Chernobyl accident. Otway, H.; Haastrup, P.; Cannell, W. (Commission of the European Communities, Luxembourg). 1987. 76p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752573/JAW.

The print media coverage of the Chernobyl accident was analysed in seven European countries. The goal was to identify common communications problems and to suggest how they might be resolved. Aside from difficulties with technical information on units of radiation exposure, contamination, and effects, the media did a reasonably good job of presenting to the public the information they were given by official sources. Some evidence of confusion was found, and it affected the credibility of communications, but the press seemed to be reflecting confusion existing within crisis management teams and the scientific community rather than creating it. Some of the more common problems are discussed and ideas for improving crisis management and the communication of information about risks are explored.

36396 (FEI—1857) Functional possibilities of program complex for diagnostics and evaluation of residual resources of some elements of nuclear power plants. Bogomolov, V.N.; Makarova, I.N.; Puchkov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701971/JAW.

Development and construction of modern systems of technical diagnostics are one of the ways for providing NPP trouble-free operation. Technique for diagnostics and estimation of residual resources containing the following stages has been suggested earlier: construction of standard mathematical models, calculation of residuals (differences between observed and calculated parameter values); revealing residual trends and predicting output parameter values. A set of programs being a part of a special software of diagnostic complex has been developed to support this technique. The "off-line diagnostics" system is used to analyse data from operating NPPs and to work off algorithms of their technical state diagnostics. Its use permitted to considerably increase the data processing efficiency.

36397 (GAO/RCED—86-213BR) Nuclear safety: Comparison of DOE's Hanford n-reactor with the Chernobyl reactor. (General Accounting Office, Washington, DC (USA)). 1986. 62p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO found that many differences exist between the Department of Energy's N-Reactor and the reactor near Chernobyl. One of the most significant differences involves the reactors' inherent physics responses to increases in coolant temperature. Other differences are (1) N-Reactor uses a metal form of uranium fuel, while the Chernobyl reactor uses an oxide form of uranium fuel and (2) N-Reactor uses once-through emergency cooling rather than a recirculating emergency cooling system like Chernobyl's. GAO found that the overall safety of N-Reactor relies heavily on successful operation of a different type of system - a reactor confinement system. N-Reactor has been operating 3 years beyond its expected life, and many systems and components are deteriorating. Maintaining safe operations through the mid-1990s will require considerable upgrading and rehabilitation. To extend safe operation of N-Reactor beyond the year 2000, major renovations - costing as much as $1.2 billion - will be required.

36398 (GAO/RCED—87-124) Nuclear regulation: A perspective on liability protection for a nuclear plant accident. (General Accounting Office, Washington, DC (USA)). 1987. 48p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Price-Anderson Act encourages private industry development of nuclear energy. It establishes a source of funds to compensate personal injury and property damage from a nuclear accident and limits the liability of private industry for such accidents. The indemnity provisions of the act, which allow the Nuclear Regulatory Commission and the Department of Energy to enter into new indemnity agreements and set the liability limits, expire in August 1987. GAO believes that the act's indemnity authority should be extended and that its liability protection is too low to provide reasonable compensation for the worst nuclear plant accident. The financial consequences of a catastrophic accident at 115 of 119 plants could far exceed the liability limit. The act covers all off-site accident damages resulting from the release of radioactive material. However, it does not clearly state whether the costs for a precautionary evacuation are covered when a release appears imminent but does not actually occur.

36399 (GRS-F—160) Reports on research programs in the field of reactor safety sponsored by the Federal Ministry of Research and Technology. Reported period: January 1-June 30, 1987. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Oct 1987. 327p. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88753539/JAW.

Investigations on the safety of light water reactors (LWR) being performed in the framework of the research program on reactor safety (RS-projects) are sponsored by the Federal Ministry for Research and Technology (BMFT). Objective of this program is to investigate in greater detail the safety margins of nuclear power plants and their systems and the further development of safety technology. Besides the investigations of LWR tasks also projects on the safety of advanced reactors are sponsored by the BMFT. The individual reports are classified according to the research program on the safety of LWRs 1977-1980 of the BMFT. Another table of contents uses the same classification system as applied in the nuclear safety index of the CEC (Commission of the European Communities) and the OECD (Organization for Economic Cooperation and Development). The reports are arranged in the sequence of their project numbers.

36400 (IAEA-INSAG-TN—2) Importance for nuclear safety of efficient feedback of operational experience. Report by the International Nuclear Safety Advisory Group. (International Atomic Energy Agency, Vienna (Austria)). Sep 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701985/JAW.

Experience of practical operation is a valuable source of information for improving and optimizing the safety and reliability of nuclear power plants. Therefore it is essential to collect information on abnormal events occurring at plants during operation and on all deviations from normal performance by systems and personnel that could be precursors of accidents. For this purpose it is necessary to establish hierarchical systems to feedback operational safety experience at utility, national and international levels and to make these systems as effective as possible. The present report attempts to identify the safety objectives of these systems, to analyse the difficulties presently encountered and to suggest possible improvements.

36401 (INIS-BR—1047) Regulatory activities in reactor safety. Salvatore, J.E.L. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1987. 50p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702311/JAW.

The safety philosophy in designs and operation of nuclear power plants and, the steps for evaluating the safety and quality assurance, in the licensing procedure are described. The CNEN organization structure and the licensing procedure for nuclear power plants in Brazil are presented. (M.C.K.).

36402 (INIS-GB—134) Statement on nuclear incidents at nuclear installations -third quarter 1987. (Health and Safety Executive, London (UK)). 29 Mar 1988. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753515/JAW.

Four incidents are reported. Carbon dioxide containing a small amount of radioactive material was released at the Chapelcross works of British Nuclear Fuels. However, air monitoring showed the contamination to be small. Surfaces contaminated were cleaned and the reactor was allowed to restart as scheduled. Refurbishment work at the Berkeley Nuclear Power Station sewage plant revealed five radioactive particles. The sludge has been isolated until a disposal method is found. Contamination on a coverall was found at the Sellafield reprocessing plant. Both the operators who may have worn the coverall may have received excess doses. Improvements in the possible source of contamination have been made. A leak of gas from the Hunterston B nuclear power station was found to be from a failed joint on a bolted flange on the bypass circuit heat exchanger. The joint has been repaired. (U.K.).

36403 (INIS-mf—11222, pp 119-124) Use of probability risk assessment method for assessing nuclear power plant safety. Suchomel, J. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)). 1987. (In Slovak). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The advantages are characterized of the method of the probability safety assessment in the sense of the application of the probability risk assessment method to problems of nuclear power plant safety. The advantages consists in that the method systematically and genuinely integrates in a unified system all safety aspects: project charactrisitcs of nuclear power plants, operating procedures, operating experience, reliability of equipment, reliability of the human factor, physical processes during reactor core meltdown accidents and the potential health hazards and effects of accidents on the environment of nuclear power plants. The development is described of the methods of probability safety assessment and the main knowledge is summed up relating to their application with regard to the damage of reactor core, and the general aspects of nuclear power plant hazards. (Z.M.).

36404 (INIS-mf—11222, pp 125-131) Trends in development of method of probability assessment of nuclear power plant safety. Dach, K. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

Trends are discussed in the development of methods of the probability safety assessment of nuclear power plants. The research effort is focused on the study of uncertainties, the study of the human factor effect, the study of failures with common cause and

on the creation of expert systems. It is stated that at present the methods of probability assessment of safety are suitable for assessing the safety of nuclear power plants allowing the use of detailed knowledge of risks for raising the level of nuclear safety. At the present level of development they can serve as an important instrument for improving the quality of safety documentation and the decision-making sphere. (Z.M.). 2 figs., 3 tabs., 4 refs.

36405 (INIS-mf—11222, pp 132-145) **Problems of impact load on nuclear power plant structures.** Adamik, V.; Matejovic, P. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The most important aspects are summed up of aircraft accidents as this type of accident covers all possible types of impact loads, external and internal for nuclear power plants. The philosophy is presented of approaches to the solution of these problems and concrete technical procedures are given. The analysis of the present state of the solution of this problem area shows that the local behaviour of reinforced concrete will have to be studied under impact load as well as the protection of internals of affected buildings with regard to induced vibrations. (Z.M.). 9 figs., 2 tabs., 23 refs.

36406 (INIS-mf—11222, pp 146-150) **Effect of external load on nuclear power plant building technology.** Ricicha, P. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

A brief characteristics is presented of the program for the calculation of effects of external load on nuclear power plant structures. The program is designed for the calculation of short-term dynamic effects when the interval of solution does not exceed the multiple of the longest eigenperiod of the linearized system. It uses direct integration of equations of motion. The range of the usability of the program depends on the element library. Available at present there are five elements of deformation type in which the primary approximated variables are the shift or the rotation. Graphically illustrated are the results of three nonlinearized solutions: the deflection of axially symmetrical thin spherical cap, the deflection of the reinforced concrete beam and the deflection of the cooling tower as a result of impact of an air pressure wave from the explosion of a gas cloud. (Z.M.). 5 figs.

36407 (INIS-mf—11222, pp 151-156) **Failure probability for nuclear power plant components at seismic load.** Pecinka, L. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The probability is discussed of the failure of components of nuclear power plants by earthquakes which may initiate a loss of coolant accident and also certain transient processes. Briefly described is a mathematical model based on the determination of such a value of subgrade acceleration which will cause the exhaustion of the material reserves of the component and thereby its fracture or loss of functional ability. The application of this model is demonstrated on the calculation of the probability failure of the main circulating pipe of the Dukovany nuclear power plant. (Z.M.). 8 refs.

36408 (INIS-mf—11222) **Safety and operating reliability of reactor WWER. External load.** Pecinka, L. (ed.). (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1987. 158p. (In Czech and Slovak). (CONF-8611245—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW.

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The Proceedings from the seminar "Safety and operating reliability of reactor WWER - external load" held in Marianske Lazne (CS), November 5 to 6, 1986, comprises the full texts of 19 papers of which 16 belong in the INIS Subject Scope. The seminar was the fifth in the regular cycle which has been held every two years since 1978 and was initially focused only on seismic load. The papers deal with the results of the geophysical survey of future sites of Czechoslovak nuclear plants, novelities in geophysics, seismic tests of the Mochovce nuclear power plant and the method of the probability risk assessment which presents a qualitatively novel view of nuclear safety. (Z.M.). 124 figs., 44 tabs., 261 refs.

36409 (INIS-mf—11222, pp 57-64) **Some experience from seismic check-ups of components of Mochovce nuclear power plant.** Masopust, R. (Vystavba Elektraren Skoda, Prague (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The first Czechoslovak nuclear power plant with the so-called partial anti-seismic design will be built in Mochovce. The evaluation of seismic resistance is prescribed only for equipment and systems which secure the safe reactor shutdown, the withdrawal of residual heat and prevent uncontrolled release of radioactivity into the environment. The following variants were compared in the calculation analysis of the primary loop of the WWER-440 reactor for the Mochovce nuclear power plant: the seismically unsecured loop of a usual design for WWER-440 nuclear power plants, the loop provided with mechanical or hydraulic dampers and the loop provided with viscose shock absorbers. The tests showed that technically most suitable is the use of viscose shock absorbers which do not completely block the movement of the system during the earthquake but absorb it intensively. The viscose shock absorbers are also much cheaper than the dampers. Briefly described is experience with the experimental evaluation of the seismic resistance of components of the Mochovce nuclear power plant. Great difficulty was encountered by the non-existence in Czechoslovakia of a seismic table allowing simultaneous excitation in the vertical and horizontal directions. (Z.M.). 18 refs.

36410 (INIS-mf—11222, pp 65-69) **Experience from seismic check-ups of nuclear power plant components.** Podrouzek, J. (Vystavba Elektraren Skoda, Prague (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The experience is discussed with seismic tests of technological equipment of conventional power plants exported from the Czechoslovak Socialist Republic to seismic regions which are being used at the Mochovce nuclear power plant. The calculation assessment of seismic resistance was made mainly at the SKODA enterprise. There are certain difficulties with experimental assessment because Czechoslovakia only has three large testing units and several small test stands. This mainly concerns electrical equipment, measurement systems and control system and air technology systems whose seismic resistance can only be tested experimentally. There are also unsolved problems concerning the classification of systems, namely to determine which systems are to be tested for seismic resistance and which are not. Breifly described are existing problems of seismic tests of equipment for the Temelin nuclear power plant. Next to the primary coolant circuit which as seismically resistant will be delivered from the USSR it will be necessary to test the seismic resistance of the live steam inlet tubing for the turbine, the condenser mounting, high- and low-voltage distribution systems, etc. (Z.M.). 15 refs.

36411 (INIS-mf—11222, pp 70-79) **Seismic analysis of V 213-C reactor for Mochovce nuclear power plant.** Zeman, V. (Vysoka Skola Strojni a Elektrotechnicka, Plzen (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The mathematical model is described of the V 213-C reactor serving the seismic analysis made for the Mochovce nuclear power plant. As against the original model the model of the upper reactor part was detailed and was divided into two subsystems. This is a discrete dynamic model with 24 degrees of freedom. The model allows to obtain seismic response of the reactor by the spectrum response method. This is done using the SEIZ3 program written in FORTRAN IV. Next to the said spectrum response method a new method was processed and applied based on approaches of stochastic dynamics, namely the so-called scatter method. For this mehod a program was written in FORTRAN IV under the name STOCHA1 whose input parameters are based on SEIZ3 program outputs. Some results of calcultions are presented in tables and graphs. (Z.M.). 4 figs., 2 tabs., 6 refs.

36412 (INIS-mf—11222, pp 80-84) **Calculation of shell components of V 213-C reactor for Mochovce nuclear power plant.** Cechura, M. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

Briefly described is the calculation of the stress of the support cylinder of the V 213-C reactor for the Mochovce nuclear power plant. The support cylinder is a thin-walled cylindrical shell with the diameter and wall thickness graded by height. The respective equation of motion was solved by numerical integration and the stochastic modal method. It is stated that numerical integration gives more accurate results but is more demanding on calculation time. The stochastic method is quicker but the accurate result strongly depends on suitably selected input conditions. (Z.M.). 1 fig., 7 refs.

36413 (INIS-mf—11222, pp 85-94) **Seismic calculation of supporting nodes and large-size parts of shielding for Mochovce nuclear power plant.** Pysek, J. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

Some results are presented of seismic calculation of the suport node and shielding parts of the V 213-C reactor for the Mochovce nuclear power plant. The support node represents the system fixing the pressure vessel in the shaft in the flange joint area. It functions as a support transmitting horizontal forces acting on the pressure vessel and prevents the rotation of the pressure vessel around its longitudinal axis. (Z.M.). 9 figs., 4 tabs., 4 refs.

36414 (INIS-mf—11222, pp 95-103) **Effect of friction on static and dynamic behavior of piping systems.** Rejent, B.; Kosek, Z. (Energoprojekt, Prague (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

As concerns the Mochovce and Temelin nuclear power plants, the construction of piping systems must not only meet the conditions of static strength but also of seismic resistance. Friction forces in the supports of piping systems are high and substantially change the character of deformations and the level of real strain in the system. In view of the fact that problems relating to significant friction have not as yet been resolved even in the statics and dynamics of machines and structures, a simplified specific technical solution is devised for the solution of the said technical problem. The soution consists in reducing resistance by mounting the horizontal tubing paths on pairs of material which are permissible with regard to static load capacity and also provide seismic resistance. The limits are determined of the coefficient of friction in the supports which with sufficient safety meet the seismic conditions of the Czechoslovak territory. (Z.M.). 8 figs., 10 refs.

36415 (INIS-mf—11222, pp 116-118) **Standard-based calculational check-ups of seismic effects on first class piping.** Roucka, M. (Kralovopolska Strojirna, Brno (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702804/JAW. (CONF-8611245—).

From 5. seminar on safety and operating reliability of reactor WWER; Marianske Lazne, Czechoslovakia (5 Nov 1986).

The problems are discussed of the application of valid standards in the calculation of seismic effects on the piping systems of the Mochovce nuclear power plant. The calculations may be made using accelerograms, e.g., by the method of numerical integration, or using the spectrum response method. (Z.M.). 4 tabs.

36416 (ITEF—194(1986)) **Some problems of the modified TVR-M reactor safety.** Mikhajlov, V.M.; Myrtsymova, L.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702108/JAW.

Some physical aspects, concerning the safety of the modernized TVR-M reactor and its temporary spent fuel storage facility are considered. Delayed neutron efficiency and neutron lifetime in the reactor are calculated. Changes of multiplication factor during moderator and coolant draining and reduction of control rod worths in the reactor with lightwater coolant are determined. Subcriticality degree of the melted reactor core and the storage facility with heavy and light water is obtained. Reduction of energy release during safety rod (SR) drop is calculated. It is shown, that the reactor core meltdown in the case of the maximum hypothetical accident does not lead to critical mass occurance. During SR emergency drop and reactor shutdown the energy release in it is decreased up to 10% for 10s and up to 1% for an hour. It is shown, that when the coolant circuit is filled with light water the reactor becomes over critical with all control and safety rods being dropped. Therefore, for the reactor core emergency cooling in the case of complete heavy water (coolant) loss it is required to develop additional technical and organization procedures. 6 refs.; 8 tabs.

36417 (IWGATWR—1-2, pp 38-40) **Safety concept and development of nuclear power engineering.** Ponomarev-Stepnoj, N.N.; Protsenko, A.N.; Slesarev, I.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Dec 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702119/JAW. (CONF-8705279—).

From 1. meeting of the international working group on advanced technologies for water cooled reactors; Vienna, Austria (18 May 1987).

36418 (KTA-GS—53) **KTA status report II/1987 (June 1, 1987-December 1, 1987).** (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)). Dec 1987. 58p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753584/JAW.

The status report II/87 gives an account of the KTA activities and achievements in the regulatory sector in the period of the 41th KTA meeting (June 1 to December 1, 1987). The survey of rules and codes approved of has been elaborated in cooperation with the chairmen of the working groups and sub-committees. The report is intended to provide quick information on developments in the nuclear regulatory system. Information on regulatory work in progress is given in the KTA manual, indicating changes e.g. in subject fields, technical details, time-schedules, or members of working groups.

36419 (NUREG—1266-Vol.2) **NRC [Nuclear Regulatory Commission] safety research in support of regulation, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). May 1988. 57p. NTIS, PC A04/MF A01 - GPO. Order Number TI88010188/JAW.

This report, the third in a series of annual reports, was prepared in response to congressional inquiries concerning how nucle-

ar regulatory research is used. It summarizes the accomplishments of the Office of Nuclear Regulatory Research during 1987. The goal of this office is to ensure that research provides the technical bases for rulemaking and for related decisions in support of NRC licensing and inspection activities. This report describes both the direct contributions to scientific and technical knowledge with regard to nuclear safety and their regulatory applications.

38420 (NUREG—1320) Nuclear fuel cycle facility accident analysis handbook. Ayer, J.E.; Clark, A.T.; Loysen, P.; Ballinger, M.Y.; Mishima, J.; Owczarski, P.C.; Gregory, W.S.; Nichols, B.D. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Industrial and Medical Nuclear Safety). May 1988. 522p. NTIS, PC A22/MF A01 - GPO. Order Number TI88011368/JAW.

The Accident Analysis Handbook (AAH) covers four generic facilities: fuel manufacturing, fuel reprocessing, waste storage/solidification, and spent fuel storage; and six accident types: fire, explosion, tornado, criticality, spill, and equipment failure. These are the accident types considered to make major contributions to the radiological risk from accidents in nuclear fuel cycle facility operations. The AAH will enable the user to calculate source term releases from accident scenarios manually or by computer. A major feature of the AAH is development of accident sample problems to provide input to source term analysis methods and transport computer codes. Sample problems and illustrative examples for different accident types are included in the AAH.

38421 (NUREG/CR—4836) Approaches to uncertainty analysis in probabilistic risk assessment. Bohn, M.P.; Wheeler, T.A.; Parry, G.W. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 7p. (SAND—87-0871). NTIS, PC A06/MF A01 - GPO;1. Order Number TI88009290/JAW.

An integral part of any probabilistic risk assessment (PRA) is the performance of an uncertainty analysis to quantify the uncertainty in the point estimates of the risk measures considered. While a variety of classical methods of uncertainty analysis exist, application of these methods and developing new techniques consistent with existing PRA data bases and the need for expert (subjective) input has been an area of considerable interest since the pioneering Reactor Safety Study (WASH-1400) in 1975. This report presents the results of a critical review of existing methods for performing uncertainty analyses for PRAs, with special emphasis on identifying data base limitations on the various methods. Both classical and Baysian approaches have been examined. This work was funded by the US Nuclear Regulatory Commission in support of its ongoing full-scope PRA of the LaSalle nuclear power station. Thus in addition to the review, this report contains recommendations for a suitable uncertainty analysis methodology for the LaSalle PRA.

38422 (NUREG/CR—5113) Findings of the Peer Review Panel on the Draft Reactor Risk Reference Document, NUREG-1150. Kastenberg, W.E.; Apostolakis, G.; Bickel, J.H.; Blond, R.M.; Board, S.J.; Epstein, M.; Hofmann, P.; King, F.K.; Ostrach, S.; Reed, J.W. (Nuclear Regulatory Commission, Washington, DC (USA); Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 228p. (UCID—21346). NTIS, PC A10/MF A01 - GPO;1. Order Number TI88011713/JAW.

This report contains the finding of the {open+-quotes}NUREG-1150 Peer Review Panel{close+-quotes} on the methodology and results presented in the Draft Reactor Risk Reference Study (NUREG-1150) and supporting documentation. The report consists of two principal parts: the chairman's report, which summarizes the principal issues of the review, and the individual members' reports, which supply the individual findings and technical details of the fourteen reviewers.

38423 (OEFZS—4413) Severe fuel damage projects. Sdouz, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Oct 1987. 58p. (In German). (RS—297/87). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702204/JAW.

After the descriptions of the generation of a Severe Fuel Damage Accident in a LWR the hypothetical course of such an accident is explained. Then the most significant projects are described. At each project the experimental facility, the most important results and the concluding models and codes are discussed. The selection of the projects is concentrated on the German Projekt Nukleare Sicherheit (PNS), tests performed at the Idaho National Engineering Laboratory (INEL) and smaller projects in France and Great Britain. 25 refs., 26 figs.

38424 (SAND—87-1048C) IFCI: An integrated code for calculation of all phases of fuel-coolant interactions. Young, M.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-880724—8). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88005105/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

A problem of considerable interest in reactor safety is the possibility of molten fuel-coolant interactions (FCIs) occurring during a hypothetical light water reactor core meltdown accident. These interactions may occur under a variety of conditions either within the reactor vessel or in the reactor cavity. The IFCI computer code is being developed to investigate the FCI problem at reactor scale in as mechanistic a manner as possible. This paper discusses the main features of the IFCI code and the results of the first test problem run with IFCI.

38425 (SAND—87-2376C) On the melting of reactor core particle beds. Dosanjh, S.S. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 32p. (CONF-880724—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88004683/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

During severe nuclear reactor accidents similar to Three-Mile Island, fragmentation of the fuel rods can convert the reactor core into a large rubble bed composed primarily of UO_2 and ZrO_2 particles. In the present study a one-dimensional model is developed for the melting and refreezing of such a bed. The analysis includes mass conservation equations for the species of interest (UO_2 and ZrO_2); a momentum equation that represents a balance among drag, capillary and gravity forces; an energy equation which incorporates the effects of convection by the melt, radiation and conduction through the bed and internal heat generation; and a UO/sub 2-ZrO{sub 2/ phase diagram. A few key results are that (1) capillary forces are only important in beds composed of particles smaller than a few millimeters in diameter and in such beds, melt relocates both upward and downward until it freezes, forming crusted regions above and below the melt zone; (2) as melt flows downward and freezes, a flow blockage forms near the bottom of the bed and the location of this blockage is determined by the bottom thermal boundary layer thickness; (3) the maximum thickness of the lower crust increases linearly with the height of the bed; and (4) deviations from intially uniform composition profiles occur because ZrO_2 is preferentially melted and these deviations decrease as the initial ZrO_2 concentration is increased.

38426 (SAND—87-2467C) Recent fuel-coolant interaction experiments conducted in the FITS [Fully Instrumented Test Site] vessel. Marshall, B.W. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 17p. (CONF-880724—10). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88005734/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

The US Nuclear Regulatory Commission has been sponsoring research at Sandia National Laboratories to investigate the interaction of molten core materials with water. These interactions play an important role during severe core-melt accidents inside a pressurized light water reactor. They influence the rates and magnitudes of hydrogen and steam generated, the characteristics of the debris bed created in the lower plenum after melt-relocation, the transient pressurization of the primary system, and the fission product release characteristics and timimg. Furthermore, since the core

is cooled with water, an understanding of the parameters that control the behavior of these fuel-coolant interactions (FCIs) is necessary to make correct accident-management decisions. In an effort to assist in the understanding of these and other FCI-related issues, as well as provide important data for model development and validation, six FCI experiments were conducted at Sandia. Results discussed include the transient gas-phase pressures, the rate and magnitude of hydrogen generation and the post-test debris characteristics.

36427 **(SAND—88-0011C) Characterization of the internal event frequencies for the final NUREG-1150.** Camp, A.L.; Cramond, W.R. (Sandia National Labs., Albuquerque, NM (USA)). 30 Jun 1988. Contract AC04-76DP00789. 6p. (CONF-880601—7). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88004692/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

NUREG-1150 represents an attempt by the Nuclear Regulatory Commission (NRC) to characterize the risk from a selected group of commercial nuclear power plants. In support of that effort, the NRC is sponsoring the Accident Sequence Evaluation Program at Sandia National Laboratories (SNL) to provide estimates of the internal event core damage frequencies for the Surry, Sequoyah, Peach Bottom, and Grand Gulf power plants. Initial results and the accompanying methodology were published during 1987 in several volumes as NUREG/CR-4550 to support the release of the draft NUREG-1150. The mean core damage frequencies were relatively low, ranging from 8E-6 to 1E-4. As a result of the public comments and various peer reviews, the analyses are being revised to support issuance of the final NUREG-1150 in the late summer of 1988. This paper describes the changes in the sequence frequencies that have occurred, presents the insights that have been obtained from these studies, and identifies certain limitations that still remain.

36428 **(SAND—88-0263C) MELPPROG debris meltdown model and validation experiments.** Dosanjh, S.S.; Gauntt, R.O. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 19p. (CONF-880724—13). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006498/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

The MELPROG computer code is being developed to provide mechanistic treatment of Light Water Reactor (LWR) accidents from accident initiation through vessel failure. This paper describes a two-dimensional (r-z) debris meltdown model that is being developed for use in the MELPROG code and discusses validation experiments. Of interest to this study is melt progression in particle beds that can form in both the reactor core and the lower plenum during severe LWR accidents. Key results are (1) a dense metallic crust is created near the bottom of the bed as molten materials flow downward and freeze; (2) liquid accumulates above the blockage as solid continues to melt and if Zirconium is present, the pool grows rapidly as the molten Zr dissolves both UO_2 and ZrO_2 particles; (3a) if the melt wets the solid, a fraction of the melt flows radially outward under the action of capillary forces and freezes near the radial boundary; and (3b) in a nonwetting system, all of the melt flows into the bottom of the bed. Solutions are qualitatively similar to the post-accident configuration of the Three-Mile Island (TMI-2) core. When the models discussed here are implemented in the MELPROG code, we will be able to conduct a very detailed TMI-2 calculation.

36429 **(SAND—88-0330C) Concrete containment test.** von Riesemann, W.A.; Horschel, D.S.; Clauss, D.B.; Lambert, L.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 24p. (CONF-8805117—2). NTIS, PC A03;3. Order Number DE88010520/JAW.

From NRC/MITI technical information exchange workshop; Tokyo, Japan (16 May 1988).

Sandia National Laboratories is conducting a series of research programs whose objective is to develop a suite of validated methods that can be used to predict the response of containment structures when subjected to severe accident loadings. Experiments are being conducted on scale models of containment structures, penetrations, and on sealing materials, such as O-rings. This paper presents the results of the overpressurization test of a 1:6-scale reinforced concrete containment model. The high pressure test was completed on July 29, 1987.

36430 **(SAND—88-0331C) Containment penetrations.** Clauss, D.B.; von Riesemann, W.A.; Parks, M.B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 22p. (CONF-8805117—1). NTIS, PC A03;3. Order Number DE88010502/JAW.

From NRC/MITI technical information exchange workshop; Tokyo, Japan (16 May 1988).

The performance of LWR containment buildings subject to a severe accident (i.e., an event with loads exceeding the design basis) is an important safety issue. Containment capacity, failure mode, failure size, and failure locations are important measures of containment performance. A systematic evaluation of containment performance requires consideratin of all potential failure modes, which include leakage or failure of penetrations in addition to shell failure of the containment wall. This paper reviews the status of research on the behavior of containment penetrations subject to severe accident loads. Test results and analytical procedures are briefly described, and references that include more detailed discussions are cited where available.

36431 **(SAND—88-1550C) Some uncertainties in radionuclide release during core-concrete interactions.** Williams, D.C.; Powers, D.A.; Shiver, A.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 14p. (CONF-8806143—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011491/JAW.

From 2. nuclear reactor severe accident chemistry symposium; Toronto, Canada (5 Jun 1988).

Radionuclides released during core-concrete interactions (CCI) can make a major contribution to the severe accident source term. Despite recent advances in understanding, significant uncertainties remain in the prediction of these releases. In the present paper, selected chemical issues that play an important role are discussed and their impact upon some typical calculations using the CORCON and VANESA codes are evaluated. It is shown that the uncertainty in the oxygen potential of the oxidic phase of the melt can lead to uncertainties of one to over two orders of magnitude in the release fractions for Ba, Sr, La, and Ce. Using La and Ce as examples, it is shown that questions involving speciation in the condensed phase are also capable of affecting the calculated release by one or more orders of magnitude. An activity coefficient model for cerium is introduced which reduces calculated cerium release by up to two orders of magnitude for the accident sequence considered. Some additional chemical issues are examined, including the coking reaction; the effect of the latter on the calculated releases is not large.

36432 **Core assembly storage structure.** Jones, C.E. Jr.; Brunings, J.E. (to Dept. of Energy, Washington, DC). US Patent 4,737,336. 12 Apr 1988. Filed date 4 Apr 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In a liquid metal-cooled nuclear reactor wherein the reactor core barrel and some auxiliary equipment including core assembly transfer equipment including core assembly transfer equipment are all immersed in a pool of liquid metal within a containment vessel, the reactor including an adjacent structure for the storage of core assemblies from the core barrel, the improvement in the core assembly storage structure is described comprising: an enclosed housing , substantially vertical support members interconnecting the top and bottom plates; an inlet duct in fluid communications with the interior of the housing at one end and having an opposite end in fluid communication with a source of ambient air; an exhaust duct in fluid communication with an opposite wall of the housing and having an opposite end in fluid communication with the atmosphere; thimble members extending through the top plate, support means affixed to the bottom plate and located adjacent a lower end of each of the thimbles.

36433 Fission product iodine and cesium release behavior under light water reactor accident conditions. Collins, J.L.; Osborne, M.F.; Lorenz, R.A.; Malinauskas, A.P. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). *Nuclear Technology;* **81**: No. 1, 78-94(Apr 1988).

The release behavior of the fission products iodine and cesium has been characterized in fission product release tests that have been conducted at Oak Ridge National Laboratory with highly irradiated, light water reactor fuel segments under conditions simulating severe accidents. The chemical forms of the fission products depended on the composition of the carrier gases used in the tests. In purified helium or steam-helium-hydrogen atmospheres, the behavior of the released iodine was characteristic of cesium iodide, whereas that of the cesium, which was not associated with cesium iodide, was characteristic of cesium oxide in the helium atmosphere and of cesium hydroxide in the steam-helium-hydrogen atmosphere. In the dry-air tests, iodine appeared to be in elemental form and cesium in the oxide form. In the steam-helium-hydrogen tests, the released cesium (other than CsI) significantly reacted with and was retained by hot oxidized stainless steel, zirconia, and silica surfaces. In contrast, cesium iodide appeared to be unaffected by these surfaces.

36434 The use of inherent reactivity feedbacks to improve fast reactor availability. Singer, R.M. (Argonne National Lab., EBR-II Div., Building 310, 9700 South Cass Avenue, Argonne, IL (US)). *Nuclear Technology;* **81**: No. 1, 39-51(Apr 1988).

The availability of metal-fueled fast reactors can be improved by the elimination of scrams caused by a class of low-flow events by taking into account the inherent reactivity feedbacks acting during such events. With this approach, the flow signal normally used in the loss-of-flow (LOF) protection system has its trip setpoint substantially reduced, and the power-to-flow signal is used with a normal trip setpoint. This permits the safety system to more closely monitor the safety of the reactor, i.e., its temperature rise as indicated by the power-to-flow ratio, and to avoid the initiation of a scram during an event in which the flow is decreasing but the core temperatures are remaining within prescribed limits. During such events, the inherent feedbacks act to reduce power and thereby limit any temperature or power and thereby limit any temperature or power-to-flow increases despite substantial reductions in the flow. This approach was applied to such an incident in Experimental Breeder Reactor II and was shown to avoid the scram that actually occurred while providing reactor protection. Additional calculations were performed illustrating the range of applicability of this type of LOF protection.

36435 The possibility of local detonations during degraded-core accidents in the Bellefonte nuclear power plant. Sherman, M.P.; Berman, M. (Sandia National Labs., Severe Accident Containment Response Div., Albuquerque, NM (US)). *Nuclear Technology;* **81**: No. 1, 63-77(Apr 1988).

It is possible to objectively determine whether a detonation can propagate in a given geometry (volume shape and size, obstacle configuration, degree of confinement) for a given mixture composition (concentrations of hydrogen, air, and steam); this is done by conservatively equating the detonation propagation criteria with the criteria for transition from deflagration to detonation. To reduce the degree of conservatism in this procedure, estimates of the probability of transition to detonation are constructed, based on subjective extrapolations of empirical data. A methodology is introduced that qualitatively ranks mixtures and geometries according to the degree to which they are conductive to transition to detonation. The methodology is then applied to analyzing the potential for local detonation in the Bellefonte reactor containment for a variety of accident scenarios. Based on code-calculated rates and quantities of hydrogen generation and calculated rates of transport and mixing, this methodology indicates a low potential for detonation except for one volume in a few cases.

36436 Analysis of instrument tube ruptures in the Zion-1 pressurized water reactor. Fletcher, C.D.; Bolander, M.A. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)). *Nuclear Technology;* **81**: No. 1, 52-62(Apr 1988).

In Westinghouse four-loop pressurized water reactors (PWRs), many long small-diameter instrument tubes are employed to route flux monitoring instrumentation lines from the lower plenum of the reactor vessel to a flux mapping seal table. A recent safety concern is that a seismic event could hypothetically rupture instrument tubes at the seal table, effectively causing a lower plenum small-break loss-of-coolant accident (SBLOCA). Continued cooling of the reactor core during a SBLOCA requires depressurization of the primary coolant system such that emergency core cooling (ECC) injection flow balances the break flow. For a lower plenum SBLOCA, the break remains liquid-covered, thus retarding primary coolant system depressurization. As a result, for continued cooling of the core, the break must be sufficiently small such that ECC flow balances break flow at elevated pressures. This study investigates instrument tube ruptures at the seal table location. Separate effects analyses investigate instrument tube pressure and heat loss, instrument lines remaining within the tubes, and tube nodalization effects. Systems effects analyses evaluate the significance of the safety concern through a best-estimate, single-failure analysis for the Zion-1 PWR.

36437 Stuck fuel rod capping sleeve. Gorscak, D.A.; Nilsen, R.J.; Maringo, J.J. (to Dept. of Energy, Washington, DC). US Patent 4,732,730. 22 Mar 1988. Filed date 9 May 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A stuck fuel rod capping sleeve is described comprising: an inner cylindrical sleeve made of low work hardening, highly ductile material and having tapered and split end portions; an outer cylindrical sleeve made of moderately ductile material and mounted on the inner cylindrical sleeve, the outer cylindrical sleeve having threads located at each end thereof; and a locking sleeve threaded on each end of the outer cylindrical sleeve, each locking sleeve having threads located on its exterior surface.

36438 Seismic margin reviews of nuclear power plants: identification of important functions and systems. Prassinos, P.G.; Moore, D.L.; Amico, P.J. (Lawrence Livermore National Lab., CA (USA); Energy, Inc., Kent, WA (USA); Applied Risk Technology Corp., Columbia, MD (USA)). *Reliability Engineering and System Safety;* **20**: 263-275(1988).

A study of the results of several seismic probabilistic risk assessments was performed to develop a screening approach for the assessment of the seismic margin of nuclear power plants. This screening approach combines both systems insights and fragility information to simplify the margin review process. The purpose of this paper is to present the basis and method used for the development of the systems screening portion of the seismic margin review methodology.

36439 Oxidation of zircaloy-4 in steam at 1300 to 2400°C. Prater, J.T.; Courtright, E.L. (Advanced Materials Section, Pacific Northwest Lab., Richland, WA 99352 (US)). pp 489-501 of Zirconium in the nuclear industry. Adamson, R.B.; Van Swam, L.F.P. Philadelphia, PA; ASTM (1987). (CONF-850601—).

From 7. international conference on zirconium in the nuclear industry; Strasbourg, France (24 Jun 1985).

The oxidation kinetics of Zircaloy-4 in steam have been extended to 2400°C. Growth of the ZrO_2 and α-Zr(O) layers display parabolic behavior over the entire temperature range studied; however, a discontinuity in the oxidation kinetics above 1510°C causes rates to increase above those previously established by the Baker-Just relationship. This increase coincides with tetragonal-to-cubic phase transformation in ZrO/sub 2-x/. No additional discontinuity in the oxide-growth rate is observed upon melting of Zr(O). The effects of temperature gradients have also been taken into account, and corrected values representative of near-isothermal conditions have been computed. Experiments have been performed in steam-hydrogen mixtures at 1565 and 1815°C. Concentrations of hydrogen up to 90 mol% have no effect on the oxidation kinetics. The rate-controlling factor appears to be the available flux of oxygen atoms incident to the reaction surface and is not dependent upon hydrogen content.

36440 Modular high-temperature gas-cooled reactor (MHTGR) status. Breher, W.; Neylan, A.; Shenoy, A. (GA Technologies Inc., San Diego, CA (US)). pp 1569-1574 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879274.

The MHTGR is an advanced reactor concept being developed under a cooperative program involving the U.S. Government, the nuclear industry ,and the utilities. The design utilizes basic HTGR features of ceramic fuel, helium coolant, and a graphite moderator. However, the specific size and configuration is selected to utilize the inherent safety characteristics associated with these standard features to develop passive safety systems that provide a significantly higher margin of safety and investment protection than current generation reactors. The design meets the Protection Action Guideline (PAG) limits at the 425 m site boundary, hence precluding the need for evacuation of sheltering of the public during any licensing basis event. The safe behavior is not dependent upon operator action and is insensitive to operator error. The conceptual design is presently being reviewed by the Nuclear Regulatory Commission (NRC). A safety evaluation report and licensability statement are scheduled to be issued by the NRC in January 1988. Status of the design with respect to applications, performance/operation, siting flexibility, investment protection, safety and economics are presented in this paper.

36441 Demonstration of passive safety features in EBR-II. Planchon, H.P. Jr.; Golden, G.H.; Sackett, J.I. (Argonne National Lab., Argonne, Illinois and Idaho Falls, ID (US)). pp 529-535 of Proceedings of the American power conference: Volume 49. Chicago, IL; Illinois Institute of Technology (1987). (CONF-870415—). Contract W-31-109-ENG-38.

From 49. annual American power conference; Chicago, IL, USA (27 Apr 1987).

Two tests of great importance to the design of future commercial nuclear power plants were carried out in the Experimental Breeder Reactor-II on April 3, 1986. These tests, (viewed by about 60 visitors, including 13 foreign LMR specialists) were a loss of flow without scram and a loss of heat sink without scram, both from 100% initial power. In these tests, inherent feedback shut the reactor down without damage to the fuel or other reactor components. This resulted primarily from advantageous characteristics of the metal driver fuel used in EBR-II. Work is currently underway at EBR-II to develop a control strategy and diagnostic technology that promote inherent safety and improved operational characteristics.

36442 CORCON-Mod 2 modifications: Immiscible fluid mixing and fission product vaporization. Corradini, M.L.; Gonzalez, F.; Norkus, J.K. (Dept. of Nuclear Engineering and Engineering Physics, Univ. of Wisconsin-Madison, Madison, WI 53706 (US)). pp 397-405 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The vaporization of radioactive materials during molten core concrete interactions have been determined to be an important contributor to the radiological source term in the event of reactor containment failure. Recent experiments have indicated that at modest superficial gas velocities (1-30 cm/sec), the melt may be mixed, as opposed to the stratified geometry previously assumed. The mixing of the melt has important implications for not only the heat transfer process within the melt, but also for the calculation of material vaporization and the chemical composition of the melt. Modifications have been made to the CORCON-Mod2 code to consider the mixing of the melt using results of recent experiments using simulant fluids. Also the vaporization of fission products from the melt in either the stratified or mixed configuration is calculated. The internal thermodynamic data base in CORCON has been updated and the ideal chemical equilibrium model is used to calculate the vaporization of core materials. Kinetic effects have been neglected.

36443 Impact of ZR metal and coking reactions on the fission product aerosol release during MCCI. Lee, M.; Davis, R.E.; Khatib-Rahbar, M. (Accident Analysis Group, Safety and Risk Evaluation Div., Dept. of Nuclear Energy, Brookhaven National Lab., Upton, NY (US)). pp 391-396 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

During a core meltdown accident in a light water reactor, molten core materials (corium) could leave the reactor vessel and interact with concrete. In this paper, the impact of the zirconium content of the corium pool and the coking reaction on the release of fission products during Molten Core Concrete Interactions (MCCI) are quantified using CORCONMOD2 and VANESA computer codes. Detailed calculations show that the total aerosol generation is proportional to the zirconium content of the corium pool. Among the twelve fission product groups treated by the VANESA code, CsI, Cs_2O_2 and Nb_2O_5 are completely released over the course of the coreconcrete interaction, while an insignificant quantity of Mo, Ru and ZrO_2 are predicted to be released. The release of BaO, SrO and CeO_2 increase with increased Zr content, while the release of Te and La_2O_3 are relatively unaffected by the Zr content of the corium pool. The impact of the coking reaction of the radiological releases is estimated to be significant; while the impact of the coking reaction on the aerosol production is insignificant.

36444 Investigation of molten corium-concrete interaction phenomena and aerosol release. Spencer, B.W.; Thompson, D.H.; Armstrong, D.R.; Fink, J.K.; Gunther, W.H.; Kilsdonk, D.J.; Sehgal, B.R. (Reactor Analysis and Safety Div., Argonne National Lab., 9700 South Cass Ave., Argonne, IL (US)). pp 375-381 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The Electric Power Research Institute is sponsoring a program of laboratory investigations at Argonne National Laboratory to study the interaction between molten core materials and concrete, with particular emphasis on measurements of the magnitude and chemical species present in the aerosol releases. The approach is to sustain internal heat generation in reactor-material corium using direct electrical heating. Real reactor materials (UO_2, ZrO_2, oxides of stainless steel, plus metallics) are used, with small amounts of La_2O_3, BaO, and SrO added to simulate nonvolatile fission products. In intermediate-scale scoping tests completed to date, corium inventories of up to 29 kg have been heated with power inputs in excess of 1 kWkg melt. The measured concrete ablation rates have ranged from 0.9 to 3.9 mmminute. Aerosol samples have been examined using a scanning electron microscope and show submicron particles, 2-6 micrometer spheres, and agglomerates that range from a few micrometers to strings 13 micrometers in length.

36445 Experiments related to the resuspension of aerosols during hydrogen burns. Nelson, L.S.; Guay, K.P. (Sandia National Labs., Albuquerque, NM (US)). pp 369-374 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—). Contract AC04-76DP00789.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The authors performed seven "add-on" experiments in two large combustion facilities to investigate the capability of hydrogen burns to remove simulated structural fission product aerosols previously deposited on small metal discs that have surfaces protypical of those found in nuclear reactor containments. The authors' results suggest that hydrogen combustion provides an especially effective mechanism for removal (and, presumably, resuspension) of sedimented aerosols produced in a hypothetical nuclear reactor core-degradation or core-melting accident. The presence of condensing steam does not seem to assure adhesion of sedimented aerosols during hydrogen burns. Differences are exhibited between different surfaces as well as between types of aerosol. In-depth studies will

be required to assess the impact exposure of sedimented aerosols to hydrogen burns might have on the radiological source term.

36446 **The parsec computer code for analysis of direct containment heating by dispersed debris.** Sienicki, J.J.; Spencer, B.W. (Reactor Analysis and Safety Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL (US)). pp 355-362 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

A multiphase flow and heat transfer, coupled Lagrangian and Eulerian computer program, PARSEC, has been developed to predict the heatup of a gas atmosphere resulting from the gas-driven dispersal of high temperature debris droplets/particles as well as the associated formation of aerosol by the oxidation enhanced vaporization of metal from the surfaces of the droplets, oxidation of reactive debris constituents, and generation of hydrogen. Predictions of the code and the fundamental modeling incorporated therein are in good agreement with available data on the essentially unimpeded dispersal of high temperature melts involving reactor materials in the Argonne CWTI-13 and CWTI-14 experiments as well as iron-alumina thermite in the Sandia DCH-1 test.

36447 **DHCVIM - A direct heating containment vessel interactions module.** Ginsberg, T.; Tutu, N.K. (Brookhaven National Lab., Dept. of Nuclear Energy, Upton, NY (US)). pp 347-354 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Models for prediction of direct containment heating phenomena as implemented in the DHCVIM computer module are described. The models were designed to treat thermal, chemical and hydrodynamic processes in the three regions of the Sandia National Laboratory Surtsey DCH test facility: the melt generator, cavity and vessel. The fundamental balance equations, along with constitutive relations are described. A combination of Eulerian treatment for the gas phase and Lagrangian treatment for the droplet phase is used in the modeling. Comparisons of calculations and DCH-1 test results are presented. Reasonable agreement is demonstrated for the vessel pressure rise, melt generator pressure decay and particle size distribution.

36448 **Integrated MELPROG/TRAC analyses of a PWR station blackout.** Henninger, R.; Dearing, J.F.; Kelly, J.E. (Safety Code Development, Nuclear Technology and Engineering Div., Los Alamos National Lab., Los Alamos, NM (US)). pp 326-331 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The first mechanistic analysis of the entire reactor-coolant system during a station-blackout core-meltdown accident has been made with MELPROG/TRAC. As was found in previous standalone MELPROG calculations, natural circulation within the vessel was established shortly after core uncovery. The circulation results in temperatures in the hot leg that could lead to failure and, hence, depressurization long before vessel failure. Auxiliary calculations examined the effects of debris-quenching modeling, natural convection flow around the primary loop, and late emergency core-cooling activation.

36449 **Zircaloy oxidation and hydrogen generation behavior during severe accidents.** Cronenberg, A.W.; Miller, R.W.; Osetek, D.J. (ESA, Inc., 836 Clair View, Idaho Falls, ID 83402 (US)). pp 301-306 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Zircaloy oxidation and H_2 generation data are presented for recent in-pile severe fuel damage tests. The principal questions investigated concern zircaloy melting and bundle reconfiguration effects on oxidation behavior. A comparison of H_2 generation and cladding temperature data indicate that significant oxidation occurred after the onset of fuel liquefaction. Posttest metallographic observations of the test debris also indicate a high degree of oxidation of once-molten zircaloy. Analysis of bundle reconfiguration effects indicate that essentially complete flow area blockage (>98%) would be required to retard steam flow through the degraded bundle so as to diminish H_2 production. Such extreme blockage conditions are not supported by posttest bundle examination.

36450 **Stability of zircaloy oxidation during severe LWR accidents.** Kuan, P. (Idaho National Engineering Lab., EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID 83415 (US)). pp 297-300 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—). Contract AC07-76ID01570.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The stability of zircaloy oxidation by steam at high temperatures under certain light water reactor (LWR) accident conditions is examined. When the oxidized surface radiates through a thin layer of steam to a cool heat sink, such as cooling water, it is found that the oxidation if stable, in the sense that no temperature escalation occurs due to the exothermic reaction, if (a) the temperature is below 1850 K (3330°R) and the zircaloy has been oxidized to a depth of about 15μm (5.9×10^{-4} in.), or (b) the zircaloy has been oxidized to a depth of 67 μm (2.6×10^{-3} in.), regardless of temperature.

36451 **Experimental and analytical studies of passive shutdown heat removal systems.** Pedersen, D.; Tessier, J.; Heineman, J.; Stewart, R.; Anderson, T.; August, C.; Chawla, T.; Cheung, F.B.; Despe, O.; Haupt, H.J. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL (US)). pp 145 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

A naturally circulating air stream to remove decay heat from a nuclear reactor is a key feature of advanced liquid metal reactor concepts. General Electric and Rockwell International continue to develop innovative designs aimed at improving safety and enhancing plant licensability. Argonne National Laboratory provides technical support to both. Shutdown heat removal employs a passive system that rejects heat by radiation and natural convection to air to assure adequate cooling. Although calculations indicate viability of this system, uncertainties remain with respect to particular designs, changing environmental conditions and material properties. Needed data are gathered in a facility that stimulates a full-scale segment of the reactor system.

36452 **Transient non-equilibrium two-phase flow: reflooding of a heated vertical tube under controlled oscillation inlet flow conditions.** Ng, Y.S. Berkeley, CA; Univ. of California (1986). 334p. University Microfilms Order No. 87-18,103.

Thesis (Ph. D.).

Flow oscillations have been observed in large-scale reflood experiments and are believed to significantly affect the rate of core recovery following a loss-of-coolant accident (LOCA). This work studies the effects of flow oscillations on heat transfer during oscillatory reflooding of a vertical heated tube and the nature of the resulting flow regime occurring along the flow channel. Experiments were performed using the UCB Reflood-Forced Oscillation Test Facility, which basically consisted of a test loop and associated instrumentation, data acquisition system, gamma densitometer, 30-kV power supply, oscillator, feed water supply, and data logging devices. Tests with a variety of boundary conditions all indicated that the overall tube quenching was delayed by the presence of the flow oscillations. A numerical model was developed to simulate the fast reflood runs (in which inverted annular flow occurred during upstroke). The two-fluid representation approach was quite successful in analyzing the given flow system. The present single-tube reflood model is mainly used to interpret the UCB oscillatory reflood data

as well as to elucidate the fundamental aspects of flow and heat-transfer phenomena existing in the oscillatory reflood process.

25 ENERGY STORAGE

36453 **(PB—88-933401) Energy Storage Systems: A current awareness bulletin.** Williams, L.E. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Feb 1988. 27p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008288/JAW.

Energy Storage Systems (EST) announces on a bimonthly basis the current worldwide information available on all aspect of energy storage. This publication contains the abstracts of reports, journal atricles, conference papers, patents, theses, and monographs added to the Energy Data Base (EDB) during the past two months.

2501 Magnetic

36454 **(AD-A—190196/6/XAB) Repetitive opening switches using optically activated semiconductors. Final technical report, 1 September 1984-31 August 1987.** Lee, C.H.; Rhee, M.J. (Maryland Univ., College Park (USA). Dept. of Electrical Engineering). 1 Oct 1987. 58p. NTIS, PC A04/MF A01.

This is the final technical report for a research program to study repetitive opening switches using optically activated semiconductors. This program was funded by the Air Force Office of Scientific Research for the period September 1, 1984 to August 31, 1987 under Grant No. AFOSR-84-0359. The goal of the research was to study opening-switch characteristics of various semiconductors in conjunction with inductive energy-storage systems.

36455 **(CRIE-U—87009) Survey on the civil engineering problems concerning the super-conducting magnetic energy storage (SMES).** Shin, Koichi; Kanazu, Tsutomu; Hibino, Satoshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1987. 29p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752543/JAW.

Previously published data are examined, selected and classified to identify major civil engineering technology requirements for the design and construction of facilities for superconducting magnetic energy storage (SMES). In a SMES system, an electromagnetic stress is generated in the outward direction along the coil radius. When installed in an underground cavity with a diameter of 200-500 m, it exerts a force to the external material, which changes in a one-day cycle in the range from several 10s to 100kgf/cm^2. And the rock around the cavity suffers from low temperatures because of the cooling of the system. Thus a study is required to determine the fatigue characteristics of the rock and construction materials exposed to long-period cycles of low-range temperature change. The coil should be rigid enough to avoid displacement, because superconductivity cannot be maintained if the coil undergoes an excessive strain. An analysis should be carried out, therefore, to determine the behaviors of the cavity and coil under an electromagnetic stress and during an earthquake. The effects of daily changes in magnetic field on rock, construction materials and environment have not been clarified yet. There remain problems concerning induced electric current and electrochemical corrosion. It is also necessary to develop construction methods and supporting materials that are resistant to large stresses. (4 figs, 8 tabs, 35 refs)

2506 Thermal

REFER ALSO TO CITATION(S) 35999, 36025, 36279, 36472, 36510

36456 **(BFR-R—88-1986) Aquifer heat store in a gravel deposit at the southern end of Brunnsviken. A feasibility study.** Eriksson, A.; Melin, O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 35p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752893/JAW.

This investigation has looked at the feasibility of providing seasonal storage of low-temperature water (maximum 20 degrees C) in a gravel deposit at the southern end of Brunnsviken in Stockholm. Heat would be recovered using a heat pump to raise the temperature to a suitable level for space heating and domestic hot water supply. The same heat pump would be used during the summer to provide cooling, thus recharging the store with heat and cold on a six-monthly cycle basis. If the cooling capacity is insufficient for recharging the heat store, additional heat could also be supplied by heat change with the warm surface water from Brunnsviken during the summer. A number of larger buildings, having both heating and cooling requirements, lie within the area. The total annual heating requirement has been estimated as amounting to 17 GWh and the corresponding cooling requirement to 4 GWh. The greatest volume of gravel, and therefore the maximum storage capacity, lies to the north of Sveaplan. Total storage potential is estimated as amounting to 5-10 GWh with reasonable temperature levels. The Wenner-Gren Centre and the Sveaplan Higher Secondary School are therefore felt to offer the best prospects for utilising the gravel as a heat store. (authors).

36457 **(BFR-R—90-1986) Signal analysis for design rating of heat stores.** Simonsson, B.; Svedinger, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 67p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752895/JAW.

Correctly rated and utilized heat stores provide considerable scope for improving the efficiency of energy systems for supply of heating energy to build environments. Thus, for example, the use of a heat store can reduce the need for installed peak load capacity in a production system and help to optimize the form of energy used, energy price variations and so on. This report describes a newly-developed method of applying signal analysis to measured consumption data to allow calculation of, for example: - reduction of installed peak load capacity, - required store size for various operating strategies, - required store output power, - savings associated with varying energy prices. The method can also be used to simulate and illustrate the performance of the store in relation to design temperature variations, assumed energy prices and operating strategies. The applicability of the method developed has been documented using measured data from an experimental building project at the Instrumentation Center at the Royal Institute of Technology in Stockholm. Its engineering applications is illustrated in an example from a smaller district heating system. The report also includes proposals for a number of development projects with aim of testing and further developing the method for applications within the field of electrical energy and water supply systems, as well as for industrial processes. (authors).

36458 **(BFR-R—92-1986) Energy storage in clay. A new method for construction ground heat exchangers.** Engvall, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 18p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752897/JAW.

One method of storing energy involves sensible heat storage in a body of clay. The necessary temperature changes in the clay are effected by means of a system of vertical heat exchanger pipes driven down into the ground, and through which a hot or cold liquid circulates, heating or cooling the clay. This project has been concerned with a test of a new method for installation of the heat exchanger pipes. The method involves the use of relatively light-weight equipment with which the hoses are pressed down into the ground. The equipment that has been used is similar to a hydraulic drilling rig as normally used for geotechnical investigations. The work has involved: - development of the necessary tools, - determination of the necessary press force and the possible depth to which the tools can be driven in clays of varying strenghts, - capacity testing. The trials indicate that the method is suitable where the ground consists of loose clay with a shear strength not exceeding about 20 kPa. For these conditions, the maximum depth to which the pipes can be driven is about 20 m. Stronger soil or greater driving depths require the drilling rig to be anchored, resulting in its capacity probably being too low to allow the method to be feasible.

36459 **(EUR—10614-EN/I-II) Solar assisted absorption or motor driven heat pump with earth seasonal storage. Final report. Pt. 1 and 2.** Lazzarin, R.M. (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation). 1987. 185p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

A plant composed of an energy roof, a seasonal earth storage and an absorption heat pump has been experimented. The purpose was to study the behaviour of the various components and their interaction. The surveys went on during two years. The following operations are considered: The charging of the earth storage by the energy roof and the working of an absorption heat pump connected either to the energy roof or to the earth storage.

36460 **(NEI-DK—78) Finite element method for heat and mass transport in porous structures ; Mathematical formulation and numerical techniques for program D2AQ.** Reffstrup, J.; Wuertz, J. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik; Danmarks Geologiske Undersoegelske, Copenhagen; Risoe National Lab., Roskilde (Denmark)). Nov 1982. 69p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753333/JAW.

The D2AQ model is designed primarily for the solution of coupled heat and mass transport in porous media. The finite element method has been used as numerical method in the model, that is, the finite element method is used in the spatial discretization of the problem, whereas the finite difference method is used to advance the solution in time. The model is still under development and new options are being added. In the present version the model has been used primarily to analyse how flow conditions in the aquifer are dependent on the boundary conditions used in the solution, (i.e. changes in filter settings, changes in injection temperature, etc.). The model can be used for the solution of related problems that can be described by the same mathematical formulation as mass and heat transfer problems, such as transport of solutes in porous structures and salt water intrusion. (SM).

36461 **(NEI-FI—22) Mine cavern used for heat storage in a district heating system.** Vartiainen, O.; Kilpinen, E.; Englman, T.; Lindevall, J.; Sipilae, K. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Feb 1987. 65p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752837/JAW.

A research program to utilize waste energy by storing it in the form of heated water in a mine cavern was carried out at Tyryrin Kalkkitehdas (Tytyri Lime Factory) owned by Oy Lohja Ab. The goal was to work out a suitable technical application to utilize the existing subsurface mine cavern for heat storage and to study the feasibility of various technical alternatives taking into account also the recovery of heat content of the compressors' cooling water. The storage of heated water would be accomplished at high temperature conditions, viz. between 100-55 deg C. The storage would be linked with the district heating net through at heat exchanger. Technically the existing mine cavern can be changed to the storage of heated water fairly easily. The upper part of the storage cavern the total volume of which being 245 000 cu. meter is well suitable for the purpose. Depending in the amount of heat energy being available for storage the effective water volume of ab. 63 000-88 000 cu. m is needed. As mentioned above this effective part of the storage could be located in the upper part of the excavation. The future growth of the local district heating capacity will play a very important role in the realization of the heat storage at Tyryri Plant. A strong increase of the net's heat consumption will make it possible to feed more heat directly from the heat recovery plant into the net thus less heat being left for storing.

36462 **(ORNL/TM—10715) Thermal energy storage technical progress report: April 1986-March 1987.** Tomlinson, J.J.; Taylor, M.J. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 58p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010753/JAW.

Progress in the development of Thermal Energy Storage (TES) technology under the Oak Ridge National Laboratory TES Program for the period April 1986-March 1987 is reported. Program goals and project structure are presented. Each of the projects active during this report period is discussed, and the interrelation of specific projects toward major technology transfer activities is described.

36463 **(ORNL/TM—10719) Transient thermal analysis of three latent heat storage configurations for rapid thermal charging.** Stovall, T.K. (Oak Ridge National Lab., TN (USA)). 28 Jun 1988. Contract AC05-84OR21400. 72p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008943/JAW.

A space-based thermal storage applicaton must accept large quantities of heat in a short period of time at an elevated temperature. An approximate model of a lithium hydride phase change energy storage system was used to estimate reasonable physical dimensions for this applicaton which included the use of a liquid metal heat transfer fluid. A finite difference computer code was developed and used to evaluate three methods of enhancing heat transfer in the PCM energy storage system. None of these three methods, inserting thin fins, reticulated nickel, or liquid lithium, improved the system performance by a significantly large amount. The use of a 95% void fraction reticulated nickel insert was found to increase the storage capacity of the system slightly with a small decrease in the system energy density. The addition of 10% liquid lithium was found to causes minor increases in both storage density and storage capacity with the added benefit of reducing the hydrogen pressure of the lithium hydride. 18 refs., 23 figs., 9 tabs.

36464 **(PNL-SA—15441) Potential energy storage from aquifer thermal energy storage.** Anderson, M.R.; Weijo, R.O.; Smoot, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 14p. (CONF-880212—8). NTIS, PC A03;3. Order Number DE88009482/JAW.

From 15. annual energy technology conference and exposition; Washington, DC, USA (17 Feb 1988).

Aquifer thermal energy storage (ATES) is a technology that allows energy to be stored in aquifers and retrieved when needed. With this technology, energy is transferred to and from an aquifer through a network of wells. The aquifer operates as a containment vessel that permits very little loss of stored energy. From 50% to 90% of the energy transferred to the aquifer can be recovered for use in space heating and cooling or as process heat. This paper summarizes a study conducted for the US Department of Energy's ATES Program. Pacific Northwest Laboratory conducted the study to estimate the overall potential energy savings from ATES utilization in the US. This estimate included the potential short- and long-term savings from both heating and cooling applications of ATES. The results can be used in determining the direction of research conducted on ATES, specifically whether the primary focus of research should be on heat or chill storage, and which end markets are the primary users and sources of heat or chill ATES.

36465 **(SAND—87-3061C) Prediction of velocity and temperature profiles in thermally driven gravity currents applied to stratified thermal storage tanks.** Nakos, J.T.; Wildin, M.W. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). 1988. Contract AC04-76DP00789. 27p. (CONF-880716—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88004452/JAW.

From 1. national fluid dynamics congress; Cincinnati, OH, USA (24 Jul 1988).

It has been demonstrated that one way of producing thin thermoclines in a chilled water thermal storage tank is by introducing the fluid in the form of a gravity current. Early in the flow the gravity current is controlled mainly by inertia and buoyancy forces, producing what is called the inertia-buoyancy (I-B) regime. Subsequently, the viscous force dominates inertia, and the flow is governed by viscous and buoyancy forces, resulting in the viscous-buoyancy (V-B) regime. In the work to be reported, vertical profiles of velocity and temperature in two-dimensional, thermally driven, constant inflow gravity currents were studied. This was done to provide a basis for understanding the initial stages of the formation of a thermocline. The gravity current was modelled with

three regions, the head, the main body and the mixed region. In this analysis, the head was ignored and a laminar flow model was used to predict velocity and temperature profiles in the main body near the floor and in the mixed region above the main body and behind the head. Analytical and numerical models were developed for both regimes. Major features of the I-B regime temperature above the floor to an elevation roughly equal to the top of the inlet diffuser opening and a high gradient region above the top of the inlet opening. Velocity profiles in the I-B regime velocity profiles and also higher gradients above the top of the inlet opening than those in the V-B regime. 6 refs., 8 figs.

36466 **Encapsulated sink-side thermal energy storage for pulsed space power systems.** Foote, J.P.; Morris, D.G.; Olszewski, M. (Oak Ridge National Lab., Oak Ridge, TN 37831 (US)). pp 1940-1945 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC05-84OR21400.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879184.

Inclusion of thermal energy storage in a pulsed space power supply will reduce the mass of the heat rejection system. In this mode, waste heat generated during the brief high-power burst operation is placed in the thermal store; later, the heat in the store is rejected to space via the radiator over the much longer nonoperational period of the orbit. Thus, the radiator required is of significantly smaller capacity. A candidate design for the thermal energy storage component utilizes lithium hydride encapsulated in 304L stainless steel or molybdenum in a packed-bed configuration with a lithium or sodium-potassium (NaK) heat transport fluid.

2508 Chemical

REFER ALSO TO CITATION(S) 35906

2509 Batteries

REFER ALSO TO CITATION(S) 35644, 36128, 37169

36467 **(CONF-8806127—6) Glass electrolytes and some of their applications.** Bloom, I.D.; Hash, M.C.; Heiberger, J.J.; Internoscia, M.A.; Rea, K.; Redey, L. (Argonne National Lab., IL (USA); Cincinnati Univ., OH (USA); Hope Coll., Holland, MI (USA)). 1988. Contract W-31-109-ENG-38. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011974/JAW.

From 7. DOE/EPRI beta battery workshop; Toronto, Canada (1 Jun 1988).

Electrolyte tubes have been fabricated from some high-soda glasses in the Na_2O-ZrO_2-Al_2O_3-SiO_2 system. Using these tubes, small-scale Na/S cells have been built and tested. Test results are presented, as a by-product of the sodium-ion-conducting-glass work, a miniature reference electrode/sensor with high-soda glass membrane has been developed. The reference electrode/sensor has been used to measure thermodynamically defined sodium activity for the temperature range of 100-600°C in many different electrochemical systems.

36468 **(CONF-8806127—7) Post-test observations on CSPL cells.** Smaga, J.A.; Marr, J.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011975/JAW.

From 7. DOE/EPRI beta battery workshop; Toronto, Canada (1 Jun 1988).

The sulfur electrode from Chloride Silent Power Limited (CSPL) sodium/sulfur cells has been extensively studied as one part of our post-test analysis program at Argonne National Laboratory (ANL). The sulfur in electrodes from charged cells tended to settle in the base of the electrode, but this tendency was dependent on the density of graphite fibers in the cylindrical section of the electrode. Analysis by energy dispersive spectroscopy was used to measure polarization-induced compositional gradients for rapidly cooled discharged cells. Quantitative determinations were also made of the gases within the sulfur electrode, and the composition of these gases was found to change with cycling.

36469 **(LBL—25253) Estimation of power-energy plots for secondary batteries.** McLarnon, F.R.; Cairns, E.J.; Landgrebe, A.R. (Lawrence Berkeley Lab., CA (USA); USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Energy Storage and Distribution). May 1988. Contract AC03-76SF00098. 12p. (CONF-880665—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011922/JAW.

From 33. international power source symposium; Cherry Hill, NJ, USA (13 Jun 1988).

A fast convenient method for estimating power plots for galvanic cells is discussed. Comparisons between various electrochemical couples can be made with this method, along with the evaluation of different cell designs, and parameters, such as sustained peak power, can be estimated.

36470 **(SAND—88-1321C) Component stress during freeze/thaw cycling.** Braithwaite, J.W.; Subia, S.R.; Stone, C.M.; Hammetter, W.F. (Sandia National Labs., Albuquerque, NM (USA)). 23 May 1988. Contract AC04-76DP00789. 21p. (CONF-8806127—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011204/JAW.

From 7. DOE/EPRI beta battery workshop; Toronto, Canada (1 Jun 1988).

During the past year, the feasibility and usefulness of mathematically modeling the processes occurring in Na/S cells during freeze/thaw (F/T) cycling has been demonstrated with the identification of potential stress producing phenomena. The first strain measurements on functioning cells have been completed that have shown the variable nature of the positive-electrode materials, a factor that may account for the randomness of actual F/T induced failures. Physical property measurements have quantified the important effect the presence of the graphite felt can have on Young's modulus for sulfur. With the completion of the physical-property and strain measurements in the coming year, final modification will be made to the material models contained in the thermo-mechanical code. The strain data will be used to validate the accuracy of the component stress calculations. Once validated, this code can be used to identify and simulate important aspects of various design options and to determine the feasiblity of proposed failure mechanisms. 4 refs., 10 figs., 1 tab.

36471 **(SAND—88-1322C) Effect of thermal cycling on CSPL [Chloride Silent Power Ltd.] sodium/sulfur cells.** Braithwaite, J.W.; Stackpool, F.M.; Subia, S.R.; Stone, C.M. (Sandia National Labs., Albuquerque, NM (USA); Chloride Silent Power Ltd., Runcorn (UK)). 23 May 1988. Contract AC04-76DP00789. 20p. (CONF-8806127—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011205/JAW.

From 7. DOE/EPRI beta battery workshop; Toronto, Canada (1 Jun 1988).

The initial phase of a task being performed to improve the freeze/thaw (F/T) durability of CSPL cells has been completed. Extensive experimental testing along with preliminary thero-mechanical modeling results show that intrinsic F/T durability of the CSPL-PB cell design is excellent. Additionally, the therom-mechancial modeling claculations demonstrated that the PB design may be more tolerant to undesirable conditions than conventional, higher capacity cells with larger L/D ratios. However, the results following thermal cycling of the intial battery modules that were fabricated at CSPL were not as encouraging. F/T failure increased significantly over that observed in individual cell tests. This situation may have been caused by other factors (e.g. cell production rate scale-up, poor temperature uniformity) and may not represent the inherent durability of the modules. Future activity includes characterizing cell performance in modules, completing the detailed evaluation of cell behavior, and refining the thero-mechanical model.

36472 **(SAND—88-1324C) Considerations and measurements of latent-heat-storage salts for secondary thermal battery applications.** Koenig, A.A.; Braithwaite, J.W.; Armijo, J.R. (Beta Power, Inc., Wayne, PA (USA); Sandia National Labs., Albuquerque, NM (USA)). 16 May 1988. Contract AC04-76DP00789. 21p. (CONF-8806127—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011091/JAW.

From 7. DOE/EPRI beta battery workshop; Toronto, Canada (1 Jun 1988).

Given its potential benefits, the practicality of using a latent heat-storage material as the basis for a passive thermal management system is being assessed by Chloride Silent Power Ltd. (CSPL) with technical assistance from Beta Power, Inc. and Sandia National Laboratories (SNL). Based on the experience gained in large-scale solar energy storage programs, fused salts were selected as the primary candidates for the heat-storage material. The initial phase of this assessment was directed to an EV battery being designed at CSPL for the ETX-II program. Specific tasks included the identification and characterization of potential fused salts, a determination of placement options for the salts within the battery, and an assessment of the ultimate benefit to the battery system. The results obtained to date for each of these tasks are presented in this paper.

36473 **(SAND—88-7093C) Recent developments in nickel hydrogen technology.** Beauchamp, R.L.; Dunlop, J.D. (Johnson Controls, Inc., Milwaukee, WI (USA); COMSAT Labs., Clarksburg, MD (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880665—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011248/JAW.

From 33. international power source symposium; Cherry Hill, NJ, USA (13 Jun 1988).

A program to design and develop a multikilowatt-hour nickel hydrogen battery for storing electricity from photovoltaic or other power sources is continuing under a cost sharing contract with Sandia National Laboratories. The challenge has been to dramatically reduce the first-cost of the battery to make it economically competitive, on a life-cycle cost basis, with other energy storage batteries used in terrestrial applications. The advantages offered by nickel hydrogen batteries are: (i) a long cycle life, (ii) no maintenance, and (iii) a high tolerance to abuse (2). The last characteristic is possibly the most important. It implies that there is no need for a charge controller between the solar array and the battery. This would have a beneficial effect on the installation's long term reliability and cost. It also means that one can take full advantage of the maximum output of the solar array, in contrast to systems where the controller isolates the battery during times of maximum insolation. Couple this to the battery's excellent energy efficiency and there can be a significant reduction in the size of the array. In addition, since the state-of-charge is directly related to pressure, the battery can be used as a load management system. 4 refs., 4 figs.

36474 **Electrochemical system including lamella settler crystallizer.** Maimoni, A. (to Dept. of Energy, Washington, DC). US Patent 4,735,872. 5 Apr 1988. Filed date 18 Nov 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In an electrochemical system including a cell stack, an electrolyte storage/reaction chamber means, means for circulating electrolyte from the storage/reaction chamber means, through the cell stack, and back to the storage/reaction chamber means, and means for removing solid reaction products produced in the cell stack from the electrolyte, the improvement is described comprising: the means for removing solid reaction products comprising: a lamella settler crystallizer operatively connected to the electrolyte storage/reaction chamber means, the crystallizer being positioned at an angle with respect to horizontal; means for circulating electrolyte from the storage/reaction chamber means, through the crystallizer, and back to the storage/reaction chamber means; and means operatively connected to the crystallizer for collecting products separated from the electrolyte as it passes through the crystallizer.

29 ENERGY PLANNING AND POLICY

36475 (CONF-8603244—, pp 49-65) **Energy situation in the Federal Republic of Germany and the world.** Maack, J. (Bundesverband der Energie-Abnehmer e.V. (VEA), Hannover (Germany, F.R.)). Mar 1986. (In German). NTIS (US Sales Only), PC A10. Order Number DE88770211/JAW.

From VDI-ADT annual meeting on better utilization of raw materials and energy in the textile industry; Reutlingen, F.R. Germany (14 Mar 1986).

A short report about energy consumption in the Federal Republic of Germany is followed by some remarks on the situation on the sectors mineral oil, natural gas coal and electric energy. The explanatory figures of the annex are based on figures collected until 1985.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 36483, 36503, 36519

36476 **(EMR/OEC—RR6) Energy analysis: methods, uses, implications. A review and critique of the state-of-the-art.** Winstanley, G. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Office of Energy Conservation). Feb 1976. 84p. (CE—01488). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Energy analysis is concerned with tracking physical flows of energy through the economic production system. Energy prices may not adequately reflect all the costs (environmental, social, private, intergenerational) which should ideally be considered in making decisions regarding the appropriate use of energy resources. Energy analysis, often descriptive rather than evaluative, provides additional physical information upon which normative policy descisions can be based. This paper sets out the methodological approaches which may be taken, their limitations and associated problems, and the conventions which have come to be associated with the discipline. A compete bibliography is appended. Since energy is a ubiquitous and possibly limitational factor of production, current concerns about energy price and availability have pushed the subject of energy analysis into a prominent position. An initial oversell of the technique's potential has led to the incorporation of references to energy analysis in political documents and even in law before either the methodological or philosophical questions regarding its use and implications have been carefully evaluated. It seems clear that energy analysis and its applications to policy development should still be regarded as an exploratory technique; any real assessment of its usefulness must await empirical evidence. While there is a recognition of the importance of energy as a physical input to economic activity, its relative importance among the other factors which enter the evaluation process has yet to be determined in the context of social priorities. 52 refs., 3 figs.

36477 **(IKE-K—54-17) Estimate of the energy consumption of private households in Baden-Wuerttemberg.** Klaiss, H.; Scheirle, N. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Apr 1980. 137p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753371/JAW.

The energy consumption of the private households and small consumers has had an ascending share of the total energy consumption in the last years. It is today nearly 50%. The existing energy statistics preponderantly prove no different amounts for both parts of the sector. The study in hand only refers to the private households. At first the past consumption is analysed. From 1960 to 1974 the consumption has approximately trebled, and now (1974) amounts to 7.602×10^3 t SKE. Striking is the big increase of oil and the high share for space-heating (80%). On the basis of the analysis a dynamic model is built up. By doing so, two scenarios are calculated. In the reference-scenario a further increase of consumption is computed up to 10.588×10^3 t SKE for the year 2000. The electric household effects then prove the highest increase. In the saving

variant 'off the oil' a maximum of $8.912x10^3$ t SKE results in the year 1985.

36478 **(LBL—22586) Energy assessment of Ivory Coast, Morocco, Nigeria, and Senegal.** Ghirardi, A.; Sathaye, J.; Goering, P. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88008420/JAW.

This report is an overview of the energy market in four West African countries: The Ivory Coast, Morocco, Nigeria, and Senegal. We feel these countries are representative of the West African region. Together they account for 75% of the total energy use in West Africa, 78% of GDP, and 76% of population. The purpose of the study is to analyze the evolution of energy demand in the context of the general socio-economic background of the region. The study also examines energy supply and trade related to the energy sector. The analysis focuses on the study of commercial fuels. Although we have reviewed studies of wood, solar, wind, and agricultural residues, we leave out detailed discussions of these non-commercial energy forms. The first part of the report is an assessment of the trends in energy demand in the four study countries. We discuss the main factors driving energy demand sector by sector. This is followed by a review of the primary energy resources of the countries, and of the capacity for production of secondary fuels. The last section looks at energy trade, with particular emphasis on the role of the United States.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 35676, 35681, 35682, 35684, 35842, 35843, 35845, 35847, 35848, 35927, 35954, 36290, 36476, 36516, 36555, 36604, 37784, 37851

36479 **(BFR-D—25-1986) Effects of state support on industry and on the market for solar heating, heat pumps and heat storage.** Isacson, Oe.; Ewetz, J.; Lundgren, G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752880/JAW.

The objective of this investigation has been to study in detail the effects of State energy research, development and demonstration support on industry and the market for solar heating, heat pumps and heat storage. Particular attention has been paid to demonstrating direct results from various forms of State support, and to investigating whether better results could be obtained in the future through any change to the form of support. State energy research, development and demonstration support is regarded as having been wholly decisive for technological development within the solar heating and large-scale heat storage sectors. Within the heat pump sector, State energy research, development and demonstration support and market introduction support have accelerated the market and also created markets within certain niches which the manufacturers themselves would not have been able to exploit. Indirect support in the form of training and courses at institutes of technology and universities, special courses, etc. has played an important part in establishing knowledge in all areas of the three energy technologies. Examples exist today within the solar heating sector of commercial components that have been developed with the help of State R and D support, and commercial systems are now starting to be built in the heat storage sector using a technology that has been developed in State-supported projects. (authors).

36480 **(BNL—41318) Reflections on the development of a physicist.** Chrien, R.E. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 12p. (CONF-8805133—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011515/JAW.

From Acoustics Society of America annual meeting; Seattle, WA, USA (19 May 1988).

The text of the presentation speech is presented which reviews A.H. Benade's career since 1952. (PSB)

36481 **(DOE/EA—0101) Environmental assessment of the proposed Solar Energy Research Institute facility at South Table Mountain, Jefferson County, Colorado.** (Solar Energy Research Inst., Golden, CO (USA)). 5 Feb 1980. Contract AC02-83CH10093. 163p. NTIS, PC A08;3. Order Number DE88008859/JAW.

In compliance with NEPA, this environmental assessment report examines the potential environmental impacts of constructing and operating the proposed Solar Energy Research Institute (SERI) facility at South Table Mountain, Jefferson County, Colorado. It describes the proposed office/laboratory building, testing sites and support facilities, characterizes the existing baseline environmental setting, assesses potential impacts of implementing the proposed plan, and examines reasonably available alternatives.

36482 **(PNL-SA—15690) Federal laboratories: what kind of economic impact can the region expect?.** Mohler, B.L.; Harrer, B.J.; Garrett, B.A. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 19p. (CONF-8804149—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011900/JAW.

From 22. annual Pacific Northwest economic conference; Boise, ID, USA (28 Apr 1988).

The objective of this paper is to discuss the ability of DOE and its laboratories, to impact regional economic development while addressing national needs through the mobilization of federal resources. It has become clear that an important and enduring responsibility of DOE and its laboratories should be to ensure that the results of federal research, whether in the form of knowledge or technology, are in fact, utilized in ways which foster industrial competitiveness on a global scale.

36483 **(RISO-M—2665) Inclusion of uncertainty in economic assessments of energy technologies.** Nielsen, L.H. (Risoe National Lab., Roskilde (Denmark)). Jun 1987. 167p. (In Danish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752928/JAW.

The report presents a study for taking uncertainties into account in economic assessments of energy technologies. The study has been carried out for the Nordic Council of Ministers and the Danish ministry of Energy. Probabilistic calculations and sensitivity analyses are utilized to give an overall picture of the uncertainties involved. Probability distributions on key quantitites such as levelized cost of energy in difference project assessments are calculated using Monte Carlo simulation. Calculations are performed on private and national economic basis. Employment and import effects can be taken into account. Calculations are based on detailed data for the various components and employment and import coefficients. Assumptions on overall shadow prices can enter the calculations. The approach allows all data to be stochastic variables, and stochastic interdependencies can be included. A conceptually simple procedure for stating empirical or subjective correlations in data is used. Furthermore, a facility for stating assumptions on uncertainty of fuel price forecasts has been developed. Sensitivity analyses describe the influence from individual data distributions and stochastic fuel price forecasts on the calculated overall uncertainty, and thus point out major and minor risk contributing factors. When possible a graphical presentation of data and results is chosen. The graphical presentation seems natural when displaying probabilistic information and helps to overview often many interacting uncertain quantities in the analysis. This forms an information platform upon which the decision maker can apply his basic criteria of decision. A number of examples illustrating the model developed (MUSA) are included in the report. The aim of the study has been to construct a tool for e.g. energy planners, where uncertainty aspects can be handled in a straight forward and practical way.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 35639, 35766, 35769, 35780, 35781, 35791, 35834, 35848, 35860, 35873, 35881, 35899, 36155, 36398, 36481, 36495, 36516, 36674, 37261, 37625, 37664, 37722, 37730, 37731, 37767, 37786, 37789, 37802, 37803, 37804, 37805, 37806, 37825, 37848, 37849, 37850, 37851, 37853, 37854, 38130

36484 (EUR—10633) State of the environment in the European Community 1986. (Commission of the European Communities, Luxembourg). 1986. 370p. Commission of the European communities, Luxembourg.

The report on the state of the environment in the European Community (1986) shows - within the limits of the available information - how the environment (in the Community of ten Member states) has changed in recent years, particularly in the period since the adoption of the first Community Environment Programme. It follows two earlier reports published by the Commission in 1977 and 1979, linking the state of the environment with the development of the Commission's activities in the environmental field. The present report fulfils an undertaking given by the Commission to the European Parliament to develop an information base which can improve understanding both of changes in the Community environment, and the effects of Community policies, in the environmental field and also in other areas with an impact on the environment.

36485 (IIUG-pre—87-9) Danger aversion - prevention - structural ecological orientation. Three ideal types of environmental policy. Prittwitz, V. (Wissenschaftszentrum Berlin fuer Sozialforschung gGmbH (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1987. 25p. (In German). Wissenschaftszentrum Berlin fuer Sozialforschung g.G.m.b.H. (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft.

The author analyzes three ideal types of political environmental action - danger aversion, prevention, and structural ecological orientation. These types compete, yet can also complement or mutually strengthen one another. Preventative environmental policy is thus not necessarily a synonym for good environmental policy. In its historical framework and with certain conditions under which it has an optimal effect, preventative environmental policy is merely one part of the system of political environmental action.

36486 (ORNL—6450/R3) Environmental Sciences Division environmental regulatory update table. Langston, M.E.; Nikbakht, A.; Salk, M.S. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 108p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88008951/JAW.

Environmental Sciences Division Publication No. 3054.

The Environmental Regulatory Update Table provides information on regulatory initiative so interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

36487 (ORNL—6450/R4) Environmental Sciences Division environmental regulatory update table. Langston, M.E.; Nikbakht, A.; Salk, M.S. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 116p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010763/JAW.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action. This report contains a monthly update of environmental regulatory activity that is of interest to the Department of Energy. It is provided to DOE operations and contractor staff to assist and support environmental management programs by tracking regulatory developments. Any proposed regulation that raises significant issues for any DOE operation should be reported to the Office of Environmental Guidance and Compliance.

36488 (PB—88-182597/XAB) Gene engineering of yeasts for the degradation of hazardous waste. Environmental research brief, July 1983-June 1986. Loper, L.C. (Cincinnati Univ., OH (USA). Coll. of Medicine). Jan 1988. 6p. NTIS, PC A02/MF A01.

This research examined the structure and function of cytochrome P-450 genes in yeast as a model for gene engineering such as eukaryotic P-450 enzymes for biodegradation of hazardous waste by yeasts. Saccharomyces cerevisiae and Candida tropicalis are two yeasts known to produce major P-450 enzymes. These enzymes were purified, and antibodies produced in rabbits were then used in the isolation or characterization of clones containing a P-450 gene from each organism. DNA sequence was determined for the gene isolated from S. cerevisiae and for several hundred bases of chromosomal DNA on each side of the gene, and deletion experiments in the promoter region were conducted. The deduced protein sequence from this gene was compared to those of the other known subfamilies of eukaryotic P-450 genes; the several features identified included a new homology region for these protein sequences. The C. tropicalis gene and its promoter region have been partially sequenced.

36489 (SNV—3148) Combating acidifying emissions. Swedish strategies and policies. Loevgren, K. (National Swedish Environmental Protection Board, Solna). 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752944/JAW.

Sulphur emissions in Sweden have decreased by more than two-thirds as from the peak value of the early 1970s. The emissions of nitrogen oxides increased heavily during the 1950s and the 1960s. Since 1980 they have decreased. The aim of the Swedish government is to reduce sulphur dioxide emissions by not less than 65% and nitrogen oxides emissions by 30% between the years 1980 and 1995. Swedish emissions of hydrocarbons are projected to decrease by about 30% between 1980 and 1995. Emissions must be reduced, not only in Sweden but all over Europe, if damage from acidification and air pollution is to be avoided.

36490 (WHC-SA—0068-FP) Hanford Fire Department hazardous material response program. Good, D.E. (Westinghouse Hanford Co., Richland, WA (USA)). Aug 1987. Contract AC06-87RL10930. 13p. (CONF-8708246—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009192/JAW.

From Fire protection conference; Chicago, IL, USA (25 Aug 1987).

A large number of hazardous materials are used daily in chemical processing and other operations at Hanford. These materials are transported by truck and rail and stored at various site locations. In addition a main public highway, State Route 240, runs through the Hanford Site and is used for transporting agricultural chemicals to farms and orchards in the surrounding area. An extensive plan for responding to emergencies involving radiological materials has been developed and implemented at the site. The more probable accident, that involving the spill or release of a toxic material, has recently emerged on the national scene as an area that also requires emergency preparedness planning. The Hanford Fire Department, over the past two years, has developed and implemented a Hazardous Materials Response Program (Haz-Mat) to address the increased toxic materials concern. The Fire Department Haz-Mat team and its response are an integrated part of a comprehensive Hanford Site Nonradiological Hazardous Materials Emergency Plan. 2 tabs.

36491 Environmental protection for the 1990s and beyond. Russel, M. (Oak Ridge National Lab., TN (USA)). *Environment;* **29**: No. 7, 12-15, 34-38(Sep 1987).

Four major changes taking place in environmental protection are: (1) a focus on toxic substances and their ecological impacts, (2) a shift from industrial to private citizen responsibility, (3)

new tools and strategies among the environmental professionals, and (4) shifting roles played by various levels of government and private citizens. Following a historical review which highlights the ecological and health effects of strip mining, the author explores environmental threats and protection in terms of how humans relate to natural systems. The wide dispersal of pollution sources will require changing the behavior of individuals and trading some personal freedoms in order to reduce risks. The new approach will require a more open decision making process so that citizens and institutions become partners in the effort.

36492 **Chemical emergencies: evaluation of guidelines for risk identification, assessment, and management.** Morris, S.C.; Moskowitz, P.D.; Fthenakis, V.M.; Hamilton, L.D. (Brookhaven National Lab., Upton, NY (USA)). *Environment International;* 13: No. 4-5, 305-310(1987).

In the wake of tragic accidents in Italy, India, Mexico City, and elsewhere, the Council of European Communities, the International Labor Organization, the US Environmental Protection Agency, and the World Bank have each issued guidelines for identifying, assessing, and managing risks from major hazards at industrial facilities. These guidelines are examined and compared. All treat the general problem in similar ways. Presence of a specific compound exceeding that thought to present a potential hazard to public health triggers further action. But, there are different threshold quantities among these guidelines due to different interpretations about such factors as toxicity and dispersive potential. A problem common to all guidelines is their failure to deal quantitatively with probabilities of accidents. Development of additional screening methods is recommended. 21 references, 6 tables.

2904 Natural Resources

REFER ALSO TO CITATION(S) 36509

36493 **(NEI-FI—37) Finland and energy.** (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1986. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752920/JAW.

Energy activities and development in Finland are shortly reviewed. Finland's energy consumption per capita is one of the highest in the world. The reasons for this are the heating needs and the structure of industry. All fossil fuels must be imported. Domestic energy, such as hydropower, peat and firewood in its various forms cover only about 30% of total consumption. Energy was a significant factor in the Finnish economy even before the world-wide energy crisies in early 1970's. Development of energy - efficient technology has long had a high priority in Finland. Finland is one of the leading countries using nuclear power, in 1985 38% of electricity was produced in the four nuclear power plants. For the future, the total energy consumption is expected to grow more slowly than average for the past decades. The growth is predicted to be about on half of the growth of the gross national product. That's why it is obvious that the objectives of energy conservation and more efficient use of energy, started in the Energy Policy Programme, can be achieved.

36494 **(NP—8752804) Report for the period 1. July 1986 - 30. June 1987 from the Mineral Resources Administration in Greenland.** (Raastofforvaltningen for Groenland, Copenhagen (Denmark)). Sep 1987. 80p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752804/JAW.

The Mineral Resources Administration considered licensing and application for exploration and exploitation concessions from several companies like A/S Arco Greenland, Nunaoil A/S, Arktisk Mine Kompagni A/S etc. The petroleum exploration in Jameson Land and the concession for Jameson Land were renegotiated. Greenex A/S and their mining project in Marmorilik were discussed like the continuation of the mine. The Kanumas project on exploration of petroleum in Western and Eastern Greenland contains seismic surveys and implies the cooperation with international oil companies. The economy and the environmental aspects of the different exploration project is likewise discussed. (SM).

36495 **(PB—88-863584/XAB) Polyethelene terephthalate (PET) scrap recycling. January 1973-May 1988 (Citations from the Rubber and Plastics Research Association data base). Report for January 1973-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 100p. NTIS PC N01/MF N01.

Supersedes PB—87-860854.

This bibliography contains citations concerning the recycling of polyethelene terephthalate products. Discarded bottles and household PET scrap are primary sources of this material. Recycling machinery, processes, and programs are discussed. Cable insulation, sheet films, foam products, and other products made from recycled polyethelene terephthalate are described. The impact recycling this material has on resource conservation and waste-disposal problems is evaluated. (This updated bibliography contains 209 citations, 34 of which are new entries to the previous edition.)

36496 **(SDJBA—1986) James Bay Development Corporation annual report, 1986.** (Society for the Development of James Bay and Affiliates (Canada)). 1986. 56p. (In French). (MICROLOG—88-01427). Societe de developpement de la Baie James (Quebec), 110, boulevard Matagami, C.P. 970, Matagami, P.Q., Canada J0Y 2A0; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The James Bay Development Corporation is a paragovernmental body whose objective is to promote the development and exploitation of those natural resources, other than hydroelectric, which are found in the James Bay region of Quebec. It also oversees the administration and infrastructure management in the territory. This report reviews the year's activities of the Corporation and its affiliates involved in tourism, native development, mining, and municipal affairs. Most of the report consists of financial statements.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 35955, 35982, 36001, 36521, 36523, 36557, 36636, 37676, 39000

36497 **(ANL—8010091) Argonne National Laboratory technology transfer report, FY 1987.** (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010091/JAW.

In 1985 Argonne established the Technology Transfer Center (TTC). As of the end of FY 1987, the TTC has a staff equivalent to four full-time professionals, two secretaries, and two student aides; FY 1987 ORTA funding was $220K. A network of technology transfer representatives provides windows into and out of Argonne's technical divisions on technology transfer matters. The TTC works very closely with the ARCH Develoment Corporation, a not-for-profit corporation set up to commercialize selected Argonne and University of Chicago patents. The goal of the Technology Transfer Center at Argonne is to transfer technology developed at Argonne to the domestic private sector by whatever means is most effective. The strategies by which this is accomplished are numerous and the TTC is, in effect, conducting a number of experiments to determine the most effective strategies. These include cooperative R&D agreements, work-for-others contracts, subcontracting to industry, formation of joint ventures via ARCH, residencies by industry staff at Argonne and vice versa, patent licensing and, of course, conferences, workshops and visits by industry and to industry.

36498 **(CONF-880528—6) The technical editing internship: What makes it work?.** Caruthers, C.M.; Caruthers, L.E.; Schmidt, B.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010041/JAW.

From 35. annual international technical communication conference; Philadelphia, PA, USA (10 May 1988).

The following paper presents the experiences and perceptions of the three main participants of a technical editing internship

at Argonne National Laboratory during the summer of 1986. Linda Caruthers, Clifford Caruthers, and Bryan Schmidt{emdash}teacher, supervisor, and intern, respectively{emdash}share what they received as their roles and responsibilities in guiding, managing, and becoming an entry-level technical editor. The following discussions demonstrate how the efforts of three people pursuing different objectives achieve the primary goal of all technical writers and editors: high-quality publications.

36499 (DOE/DP—8008612) Technology security: Volume 1. (USDOE Assistant Secretary for Defense Programs, Washington, DC. Office of International Security Affairs). Mar 1988. 121p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE88008612/JAW.

This study defines the scope of DOE nuclear and nuclear-related technology transfer and security interests and explains their interrelationship, describes existing programs and activities which support these interests and assesses their impact on one another, and identifies pertinent factors that should be taken into consideration in devising measures that may enhance these programs. The focus is on those DOE nuclear and nuclear-related technologies which could make significant contributions to military programs in other countries. The study examines several mechanisms which are viewed as important avenues for technology transfer, (i.e., visits assignments, and foreign travel; public releases; international activities; and clandestine acquisition). The input of various DOE program offices and laboratories was elicited. This provided the benefits of each organization's expertise in technology controls. Moreover, the responsibilities and programs of other US government agencies involved in technology controls were examined in conjunction with DOE's area of responsibilities.

36500 (NEI-FI—36) Energy research and development program. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Sep 1984. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752877/JAW.

The national economy of Finland is very energy-intensive. Finland has no high-grade fossil fuel resources, the indigenous energy sources being limited to wood, hydropower and peat. Fossil and nuclear fuels have to be imported over long distances. Energy was a key cost factor in the Finnish economy even before the oil crisis. Development of energy-efficient technology has long had a high priority in Finland. After the sharp increases in energy prices which occurred in the 1970s, the Government of Finland decided to promote energy conservation and the use of indigenous fuels. One of the key measures here was to increase government funds for energy R and D. The real value of R and D government funds doubled between 1979 and 1981. The basic guidelines for government financed R and D are set forth in the National Energy Policy Programs approved in 1979 and 1983. Based on the latter, the Ministry of Trade and Industry prepared and published its own Energy R and D Program in 1983. This program, which includes several background reports, in published in Finnish only. The present publication is an English summary of the Program, along with a few case projects and other related information.

36501 (NEI-NO—34, pp 38) **Gas technological development perspectives.** Berg, J.O. (Institutt for energiteknikk, Kjeller (Norway)). 1987. (In Norwegian). NTIS (US Sales Only), PC A10. Order Number DE88752839/JAW. (CONF-8704287—).

From Seminar on gas in Nordic energy supply; Oslo, Norway (8 Apr 1987).

The purpose of the paper is to elucidate problems and possibilities of importance for Norway's position as a gas producer and exporter. IEA's perspective analysis towards the year 2010 shows that the total consumption of gas in Europe and USA may increase by 40% and 15%, respectively. In the electric power production there is a considerable technological potential for further development of the gas turbine, and this may contribute to maintain the share of gas in the electricity production. The same may be the case in the development of fuel cells, in a somewhat longer perspective. For Norway, special technological challenges are attached to the utilization of those gas resources that cannot be transproted in pipes to the great markets of Europe in a profitable way. This gas must be utilized by conversion to electricity or liquid products, and the gas has been transported ashore in pipes, or in direct connection to the production system. In both cases it will be of vital importance to find the total system solutions which will give the best economic result. 21 refs., 9 figs.

36502 (ORAU—88/B-55) Office of Energy Research collaborative research programs administered by Oak Ridge Associated Universities: Annual report, FY 1987. (Oak Ridge Associated Universities, Inc., TN (USA)). Feb 1988. Contract AC05-76OR00033. 60p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009040/JAW.

The US Department of Energy's (DOE) Office of Energy Research (OER) sponsors programs designed to encourage and support interaction between US colleges and universities and DOE research facilities. Faculty members, graduate students, undergraduates, and recent postgraduates participate in research and receive advanced training at DOE laboratories. Staff members from DOE laboratories visit campuses to deliver energy-related lectures and participate in seminars and classroom discussions. Oak Ridge Associated Universities (ORAU) has been involved in the developemnt and administration of these collaborative research programs since their inception. During FY 1987, ORAU administered appointments for the Office of Energy Research under the following two umbrella programs: University/DOE Laboratory Cooperative Program (Lab Co-op); Science and Engineering Research Semester (SERS). In addition, ORAU participated in a project to collect and assess information from individuals who had held research appointment as undergraduate students during a four-year period from 1979 to 1982. All of these activities are summarized in this report.

36503 The role of the DOE over the next decade: A view from Washington. Stewart, F.M. Jr. (Office of State and Local Assistance Programs, US Dept. of Energy (USA)). pp 228-237 of Proceedings of the governor's conference on energy investments. Profiting from energy savings. Honolulu, HI; Dept. of Planning and Economic Development (1985). (CONF-8505319—).

From Governor's conference on energy investments: profiting from energy savings; Honolulu, HI, USA (8 May 1985).

The author discusses where the Department of Energy (DOE) stands now and where it is headed. He explains some of the new ways the DOE is getting communities involved with energy conservation. He supports three-part financing but urges companies to be concerned with who has control of the project. He says every situation in terms of energy efficiency is unique and needs to be looked at with a different perspective.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 35766, 35769, 35780, 35781, 35804, 35805, 35808, 35834, 35842, 35845, 35848, 35860, 35873, 35889, 35899, 36282, 36286, 36296, 36398, 36417, 36499, 36524, 36685, 36715, 37722, 37853, 37854

36504 (EM/R—86/6) Juridical actions against the nuclear power plant in Borssele (Netherlands). Rimmelzwaan, M.; Noort, W. van. (Rijksuniversiteit Leiden (Netherlands). Werkgroep Energie- en Milieuonderzoek). 1986. 81p. (In Dutch). Library KNAW, P.O. Box 19121, 1000 GC Amsterdam, The Netherlands.

This report deals with seven juridical actions carried on by the Dutch anti-nuclear power committee against the nuclear power plant in Borssele. refs.

36505 (EM/R—87/8) Juridical actions against nuclear power. Rimmelzwaan, M.W.A.; Noort, W.J. van. (Rijksuniversiteit Leiden (Netherlands). Werkgroep Energie- en Milieuonderzoek). 1987. 101p. (In Dutch). Library KNAW, P.O. Box 19121, 1000 GC Amsterdam (The Netherlands).

This report deals with juridical actions carried on by the Dutch anti-nuclear power action committee against the nuclear power plant in Dodewaard, KEMA, the Ultra-Centrifuge and dumping of radioactive materials. 17 refs.

36506 (IIUG/dp—87-8) Technological protest in West Germany. Signs of a politicization of production. Conrad, J. (Wissenschaftszentrum Berlin fuer Sozialforschung gGmbH (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753547/JAW.

This study deals with the question whether increasing social conflicts around technology in general as well as specific technological projects can be reasonably interpreted as evidence for a substantive politicization of production in advanced capitalist democracies with historically new social problems and cleavages. Therefore, the socio-economic conditions and determinants of technological protest, the typical features of technological controversies, and the characteristics of the German protest development are described. The available rsearch results provide some indications for the above hypotheis but do not allow any stringent conclusions yet for reasons which relate conclusively to the pattern of protest development hitherto observable, and to still existing deficits of social science research. (orig./HKP).

36507 (ND-R—1466(R)) Case for the UK nuclear power industry and the implications of its closure. Locke, D.H.; Caley, J.R. (UKAEA Northern Research Labs., Risley). Apr 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753610/JAW.

The Chernobyl accident has produced calls for a moratorium on further nuclear power development and construction in the UK or, in the extreme, a phasing out of existing nuclear power stations. Some suggestions as to how to counteract these demands have been collected using published information wherever possible.

36508 (STEV—1987-4) After Chernobyl. Possibilities of phasing out nuclear power in Sweden. (Statens Energiverk, Stockholm (Sweden)). 1987. 94p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752501/JAW.

According to the currently applicable Parliamentary decision, the phasing out of nuclear power in Sweden must be completed by the year 2010. The National Energy Administration has analyzed the following questions. If it were to become evident that operating several or all of the Swedish nuclear power plants entailed serious risks, what possibilities would there be of phasing them out in the short term or over a longer period. And what would the consequences be with regard to the national economy and the environment? First we report the consequences of a rapid phase-out. Here, it is assumed that several or all nuclear plants would be taken out of operation within a period of two years. Available compensatory resources would be limited to more intensive utilization of existing hydropower, back-pressure plants, combined power and heating plants and oil-fired plants. The second alternative is a phase-out in ten years. Moreover, a case is discussed in which phase-out is planned and implemented from 1987 to 2005. Such a plan would provide industry more time to adjust, while a number of alternative techniques and fuels could be used to replace nuclear power. The consequences of the different phase-out alternatives can be described only within a framework of certain assumptions regarding the worldwide development. Important factors here include fuel prices and economic trends. Environmental restrictions comprise another important prerequisite.

36509 (AD-A—190147/9/XAB) Nuclear power plants. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 18 Dec 1987. Trans. of mono. Zhong Guo He Xuehui (China) Sep 1986 2, 4-9, 12-13, by Randy Dorsey. (FTD-ID(RS)T—1374-87). 16p. NTIS, PC A03/MF A01.

China's energy resources are unequally divided. Most of the coal reserves are in the north and most of the water-power resources are in the western part of the country. It is imperative that nuclear power be developed in the energy-poor region of the east, the south and the northeast where industry and population is rather concentrated. Should the north's coal be transported to the south; the amount to transport is immense and this is economically unfeasible. Contents include: Nuclear Power Plants and Capacities for Various Countries and Regions of the World (As of the end of 1985); China Needs to Develop Nuclear Power; China has Already Established a Rather Comprehensive Nuclear Fuel Cycle Complex; China has the Capability to Develop Nuclear Power; Qinshan Nuclear Power Plant Under Construction; Guangdon-Daya Bay Nuclear Power Plant to be Build Under Joint Venture.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 36538, 36632, 36669

36510 (BFR-R—81-1986) Hoestvetet project in Stockholm. The suncourt system: a glazed courtyard heat pumps and a borehole heat store for an apartment building. Kellner, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 184p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88752890/JAW.

This report describes a systems incorporating seasonal heat storage in a borehole heat store in rock, built beneath a newly designed and erected apartment building containing 71 flats. The building features a glazed courtyard, from which surplus heat during the summer is used as the heat source for two heat pumps. When heat input from the courtyard is insufficent, energy is abstracted from the outside air. The suncourt project forms part of the 'Stockholm project', and will be put forward by the Swedish Council for Building Research as the Swedish contribution to the IEA/IECD energy research programme, which accounts for its English name. The 'Stockholm project' as a whole includes a furher five experimental building projects. Besides a description of the Suncourt project itself, the report also desribes the feasibility of other applications of seasonal heat storage in rock, togheter with a general description of the fire precautions and acoustic aspects applicable to glazed courtyards. (authors).

36511 (BFR-R—89-1986) Heat storage in clay for a group heating plant in Gothenburg. Part I. Overall design for an existing property. Part II. System and cost investigations. Buresten, R.; Hofgren, K.H.; Kasza, A. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 72p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752894/JAW.

Part 1 of this report describes the detailed design of a heat store constructed in clay with heat pump and wind convectors for a group heating plant owned by AB Goeteborgshem in Gothenburg. The system is intended to provide 78 percent energy coverage for 186 apartments and to operate both as seasonal heat store and as a direct outdoor air heat pump. A complete set of enquiry documentation, consisting of 20 or so drawings, has been prepared, describing in detail how the system should be designed. The work has been based on comprehensive preparatory work, including geological and geotehnical consequence analysis, allowing the system to be rated with the assistance of a computer. Architectonic and acoustic considerations were also included in the design in order to ensure that the system would melt into its environment. Tenders were subsequently invited from about ten contractors, and the replies have been used as a basis for the comparative cost calculations presented in Part 2. This includes, for example, comparison of solar collectors with wind convectors as collectors for a heat storage system. Storage technology is also compared with other possible alternatives, in this case that of a straight outdoor air heat pump with wind convectors. The conclusion is that an outdoor air heat pump alone provides the lowest total heat production cost, and that solar collectors result in higher total costs than a heat store with wind convectors. However, more fundamental economic consideration, as seen by the supplier of electrical energy, indicates that storage technology would be preferable. This is because the poorer coefficient of performance of the outdoor air heat pump results in additional costs necessitated be reinforcement of the supply system and electrical energy production in coal-fired and oil-fired condensing power plant. (authors).

36512 (BFR-R—95-1986) Cold water heat distribution system for Ekeby Soedertaelje. A feasibility study. Bodinson, L.; Malmqvist, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 41p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752899/JAW.

The objective of this work has been to investigate the technical and economic feasibility of supplying heat to an existing residential area of detached houses, using a cold heat distribution system. The thermal load density of such areas is so low that conventional district heating is seldom economic for such applications, due primarily to the high costs of the distribution system. On the other hand, a cold heat distribution system can be built for considerably less, as a result of the lower media temperature requiring less demand on materials and insulation. The report also compares a number of individual system designs. The results of the investigation show that:- The introduction of a public heat supply system in existing areas of detached housing requires a high take-up. However, the high costs make this difficult to achieve, although good long-term economics can be demonstrated. - The distance to the heat source (Lake Maelaren in the case considered here) is too great. - Cold heat distribution using surface earth layers as its heat source is the most economic public system.- If cold heat supply systems are built, established institutions such as local authority energy companies should be responsible for them. - The cheapest system today, in relation to the assumptions in the investigation, is the electric boiler. (authors).

36513 **(BFR-R—96-1986) Cold water district heating for Djuraas town centre, Gagnef. A fesibility study.** Norbaeck, K. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 40p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752900/JAW.

The objective of this project have been to investigate the technical and economic feasibility of abstracting heat from a groundwater source and using it to meet part of the energy requirements of a residential area. Two alternative proposals were investigated: 1. Supplying only three larger buildings with groundwater heat. 2. Supplying all buildings with groundwater heat. It is the intention to pump groundwater from a nearby sand/gravel ridge to the various subscribers. Heat pumps in each building would abstract heat, after which the cooled groundwater would be returned. The expected flow in the distrubution would amount to about 83 m/sb3/ per hour for Alternative 1 or about 255 m/sb3/ per hour for Alternative 2. The heat supply systems in the buildings would be complemented by heat pumps to provide a total output of about 450 kW (Alternative 1) or 1250 kW (Alternative 2). The proportion of heating energy supplied by the heat pumps would amount to about 83.5 percent or 87 percent respectively. Additional heat would be supplied from existing heat production plant. The investment cost for Alternative 1 is calculated as amounting to about SEK 3.3 milion, while that for Alternative 2 would amount to about SEK 7.95 milion. The operating cost saving for Alternative 1 would be about SEK 330,00 per year, while that for Alternative 2 would be about SEK 698,00 per year. This would give payoff times for the two alternatives of about 9.8 and 11.4 years respectively. Calculated using the present value method, both alternatives would provide positive present values during their technical/economic lives of 15 years, amounting to about SEK 833,00 and SEK 600,000 respectively.

2910 Conservation

REFER ALSO TO CITATION(S) 35684, 36535, 36554, 36604, 36606, 36674

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 35676, 35706, 35805, 35843, 35847, 36290

36514 **(NYSERDA—88-2) Potential impacts of climate change on electric utilities: Final report.** (ICF, Inc., Washington, DC (USA)). Dec 1987. 128p. New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI88010322/JAW.

This report summarizes the analytic approach and preliminary findings of a study jointly sponsored by the Edison Electric Institute, the Electric Power Research Institute, the New York State Energy Research and Development Authority, and the US Environmental Protection Agency. In addition to these organizations, an advisory board of global climate scientists and utility executives provided comment and direction during the design phase of the study. The project examines the potential impacts of greenhouse-gas-induced climate change on the demand for electricity and electric utility planning and operations in two case studies. The study focuses on the next 30 years, a period of direct relevance to utility planning, but a period of modest temperature changes compared with predictions for the latter part of the 21st Century. 23 figs., 35 tabs.

36515 **Energy demand in developing countries: A sectoral analysis of recent trends.** Sathaye, J.; Ghirardi, A.; Schipper, L. (International Energy Studies, Applied Science Div., Lawrence Berkeley Lab., Berkeley, CA 94720 (US)). pp 253-282 of Annual review of energy: Volume 12. Hollander, J.M. Palo Alto, CA; Annual Reviews Inc. (1987).

The International Energy Studies (IES) group at Lawrence Berkeley Laboratory has been one of the pioneering centers for sectoral- and end-use-oriented study of national energy consumption. In recent years, the group has developed a sectoral data base for more than 20 less developed countries (LDC). This data base is built from national, rather than international, information sources, including national statistical agencies, public and private energy-supply businesses, and local academics. In analyzing energy demand, the authors examine four sectors in each country: industry, transportation, residential/commercial, and electricity generation. They establish measures of energy intensity (energy consumption per some appropriate unit) for each sector, and seek to understand the changes in the structure of that sector that influence its energy intensity. The analysis also examines the changing fuel mix in each sector and the reasons for any change. This article presents information on sectoral energy demand and structural changes in the 1978-1984 period for 18 LDCs in Asia, Latin America, and West Africa. (Data on selected countries in the Middle East are being incorporated in the study.) It also discusses the outlook for energy demand during the next decade. Together, the 18 countries account for more than 70% of LDC energy and oil demand. Within each region, the study countries account for 75% or more of total energy demand. They include major oil-exporters and oil-importers, and vary widely in per capita income and economic growth rates.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 35766, 35780, 35791, 35834, 35899, 35948, 36282, 36290, 36484, 36486, 36487, 36489, 36493, 37626

36516 **(CONF-8509447—) Proceedings of the symposium on the epidemiologist in court.** (American Coll. of Epidemiology, Buffalo, NY). 1985. Contract FG02-85ER60384. 73p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009546/JAW.

From Conference on the epidemiologist and the law: evidence, expert witness, ethics; Santa Monica, CA, USA (20 Sep 1985).

This document contains comments by individuals experienced in the application of epidemiology to legal proceedings. The authors define the legal process as it applies to damage claims, they provide examples of significant decisions, and they explain the rules for the use of epidemiological data as evidence. 17 refs.

36517 **(DOE/OR/00033—T238) Report on identification of federal radiation issues: To the Federal Coordinating Council for Science, Engineering and Technology.** (Committee on Interagency Radiation Research and Policy Coordination, Washington, DC (USA)). Mar 1986. Contract AC05-76OR00033. 12p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE87012861/JAW.

The Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) was established on April 9, 1984 by the Office of Science and Technology Policy (OSTP) under the authority of the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). It is chaired by OSTP. CIRRPC membership consists of those agencies having specific responsibilities or interest in radiation research and/or policy. CIRRPC has two elements: The Committee itself, consisting of subcabinet and senior policy level representatives, and a Science Panel, consisting

of senior radiation scientists from the respective member agencies. The structure and membership of CIRRPC is shown in Figure 2. It was decided at the inception of CIRRPC to identify the radiation issues of concern to the Federal agencies, Congress, and professional societies faced with radiation policy or scientific issues. It was felt that a current list of national radiation issues should be assembled so that CIRRPC could concentrate on these issues and the dividends from CIRRPC's resources could be maximized at the earliest possible time. These issues are listed.

36518 **(NRRI—87-18) Administrative procedures for proactive regulation.** Burns, R.E. (National Regulatory Research Inst., Columbus, OH (USA)). Mar 1988. 140p. National Regulatory Research Institute, 1080 Carmack Road, Columbus, OH 43210. Order Number TI88008628/JAW.

This study treats two types of alternative procedures that might be used by state public utility commissions in place of trial-type, adjudicatory administrative procedures. These are procedures that can lead to more efficient determination of routine forward-looking economic, financial, and other regulatory policy issues. Since the inception of administrative law, state public utility commissions have used trial-type, adjudicatory procedures for setting rates. However, the commissions have recently been faced with complex, prospective policy issues that cannot be easily considered using adjudication. Also, many of these issues have a large number of potential solutions and any one solution will affect many of the interested parties. Indeed, the use of adjudicatory procedures when a state public utility commission deals with complex prospective policy issues may well be counterproductive. These trial-type procedures can lead to a less accurate policy decision because the procedure is inappropriate. In particular, use of a trial-type procedure creates the potential for the decision-maker to get incomplete information on an issue. Trial-type procedures remain appropriate for the routine rate case, where most of the main determinations to be made are factual.

36519 **(RISO-M—2677) Project evaluation for energy supply in rural areas of developing countries.** Christensen, J.M.; Vidal, R.V. (Risoe National Lab., Roskilde (Denmark)). May 1987. 31p. (CONF-8708249—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752932/JAW.

From 11. triennial conference on operations research; Buenos Aires, Brazil (10 Aug 1987).

This paper reports the methodological experiences of the project: "Energy Supply Technologies in Developing Countries"; carried out in collaboration with the Department of Energy, Zambia. Existing methods for project evaluation, based on cost-benefit analysis, will be briefly presented, particularly as regards their inadequacy for assessing energy projects in rural areas. An alternative practical and PC-based approach will be presented in which emphasis is placed on the problem formulation phase, including the socio-economic, cultural and political aspects of the problem. This approach has been prepared for training purposes. Finally, some methodological thoughts based on our practical experiences will be presented and our future work will be briefly discussed. 21 refs.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 35635, 35673, 35674, 35676, 35677, 35678, 35679, 35679, 35680, 35681, 35682, 35684, 35685, 35697, 35700, 35706, 35707, 35708, 35709, 35710, 36501, 36529, 36530, 36531, 36532, 36533, 36534

36520 **(EMR—25051981) Canada Oil Substitution Program.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). May 1981. vp. (CE—01501). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

As part of the National Energy Program, the Canadian government introduced the Canada Oil Substitution Program in 1981 to decrease dependence on oil supplies for home heating. The program provides financial incentives to householders to assist changing their heating systems from oil-fueled systems to those using more abundant alternate fuels, notably gas and electricity. Under this program, those whose homes are heated by oil are eligible for a taxable grant covering half the costs of approved conversions, up to a specified maximum. This press kit includes general information on criteria for eligibility and allowable expenses in determining such grants. Since the eligible fuel alternatives vary from province to province, separate brochures are included to provide information to applicants from the various parts of Canada.

36521 **(EMR/CRE—011981) New liquid fuels.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Conservation and Renewable Energy Branch). Jan 1981. 35p. (CE—01440). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Research and development (R & D) is identified in Canada's National Energy Program as a significant element of the strategy for achieving energy objectives. As one element of strategy, R & D must be planned in concert with other government policies or incentives. It must foster Canadian industry and expertise, assist in addressing regional imbalances in resource distribution, and help establish the options needed to secure an energy future. For this role to be realized, R & D priorities and planning must be guided by policy. To achieve this guidance, a planning must be guided by policy. To achieve this guidance, a planning process is proposed for liquid fuels R & D that will effectively combine policy concerns with the judgement and capabilities of the committees for key research programs. Five key research programs in new liquid fuels are identified: direct liquefaction, gasification, biological processes, fuels processing, and fuel use. Each area is itself broken down into program elements. For each element a minimum and a recommended level of resources (1981-1984) is given. Criteria are proposed that can be used to determine priorities for allocating funds between minimum and recommended levels. A number of research proposals received are also listed. By and large, these proposals are poorly defined, and lack the detail necessary for their effectiveness relative to the task in hand to be assessed. There are also significant gaps in the research covered by current proposals. In most cases, decisions to support particular proposals would be premature at this time; this emphasizes the need for an expeditious R & D planning process. 1 fig., 4 tabs.

36522 **(NEI-NO—34, pp 31) Platform for natural gas in West Germany. Gas potential, market strategies and European integration.** Bergmann, B. (Ruhrgas AG, Essen (F.R. Germany)). 1987. NTIS (US Sales Only), PC A10. Order Number DE88752839/JAW. (CONF-8704287—).

From Seminar on gas in Nordic energy supply; Oslo, Norway (8 Apr 1987).

This paper reviews the past development of the natural gas industry in West Germany and analyzes the prospects of gas on the West German energy market, while salient features which may be relevant for natural gas in Scandinavia are discussed in the second part of the paper. In the Federal Republic of Germany a medium-sized highly industrialized nation with a high population density, natural gas is sold on an energy market of a size not surpassed in any other West European country. In fact, conditions in West Germany have a certain model character, as natural gas is offered on a relatively liberal energy market. If subsidies to the West German hard coal industry are disregarded, energy supply and demand are controlled by the forces of the market. As domestic oil reserves are very small, West Geremany is highly dependent upon imported energy. Natural gas, which covers some 15% of primary energy demand, is also largely imported, mainly from West European sources. On the other hand, any comparison between the West German gas industry and the gas industries in the Nordic countries will be of limited validity, because the market for gas in West Germany has advanced to a certain maturity. If the experience made during the development of the gas industry in West Germany is to be helpful for the development of gas in the Nordic countries, the market price principle is the concept that should be transferred. It is essential, though, that project decisions are not exclusively taken in the light of the price conditions at the time of the decision, but must account for likely developments during the life of the project. 11 figs.

36523 (SOQUIP—1987) SOQUIP [Societe Quebecoise d'Initiatives Petrolieres] annual report, 1986/1987. (SOQUIP, Quebec (Canada)). 1987. 32p. (In French). (MICROLOG—88-01463). SOQUIP (Societe quebecoise d'initiatives petrolieres), 1175, rue de Lavigerie, Case Postale 10650, Ste-Foy, P.Q., Canada G1V 4P5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

SOQUIP is a corporation wholly owned by the Quebec government whose activities include oil and gas exploration and production, energy supply, natural gas distribution, and energy research and development. This report reviews the year's activity of SOQUIP and its subsidiaries (including SOQUIP Alberta, SOQUIP Atlantique and Noverco). Financial statements and production/consumption statistics are included.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 36521

2960 Electric Power

REFER ALSO TO CITATION(S) 35948, 36155, 36501, 36514, 37776, 37777, 37778, 37779, 37780, 37851

36524 (AD-A—190620/5/XAB) Optimization of some parameters of atomic steam-gas powerplant. Ratnikov, Y.F. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 21 Oct 1985. 18p. (FTD-ID(RS)T—1582-84). NTIS, PC A03/MF A01.

Unedited machine trans. of Izvestiya Vysshikh Uchebnykh Zavedeniy, Energetika (USSR) No. 6, 49-54(Jun 1972).

Determination of optimum parameters of binary-type atomic steam-gas powerplant is a difficult analytical problem in view of the complicated interdependence of parameters, which characterize the reactor, gas-turbine, and steam-turbine parts of the installation. Conclusions include: 1) Determination of optimum parameters of atomic steam-gas installation is recommended to produce with gas consumption = const and heat output of the reactor = var. since best technical-economic indices of installation correspond to this case. 2) With increase in power of atomic steam-gas installation, together with improvement in economic indices, the optimum pressure ratio descends and optimum temperature of feed water increases. 3) Increase in the fuel component leads to a decrease of optimum pressure ratio and to increase in temperature of feed water. 4) Change of cost of reactor plant over wide limits virtually does not have effect on numerical values of optimum parameters being investigated. 5) In all cases optimum pressure ratio is more, and temperature of feed water is less than outer limits, obtained by thermodynamic calculations.

36525 (DOE/EIA—0226(88/03)) Electric power monthly. (USDOE Energy Information Administration, Washington, DC). Mar 1988. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011940/JAW.

Total net generation by electric utilities in the United States for the month of March 1988 was 213,838 gigawatt-hours, 6% higher than the amount reported a year ago. Net generation using coal, gas, and nuclear power was higher (7, 8, and 18%, respectively) as compared to March 1987. Petroleum and water were the only two energy sources with lower levels of net generation than was reported in March 1987. Petroleum-fired generation was off 2% and hydroelectric generation was down 3 percent as compared to a year ago.

36526 (DOE/EIA—0397(87/4Q)) Electric power quarterly, October-December 1987. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 19 Apr 1988. 349p. NTIS, PC A15/MF A01 - GPO;1; GPO Dep. Order Number DE88009294/JAW.

The EPQ presents monthly summaries of electric utility statistics at the national, divisional, state, company, and plant levels on the following subjects: quantity of fuel, cost of fuel, quality of fuel, net generation, fuel consumption, and fuel stocks. In addition, the EPQ presents a quarterly summary of reported major disturbances and unusual occurrences. These data are collected on the Form IE-417R. Every electric utility engaged in the generation, transmission, or distribution of electric energy must file a report with DOE if it experiences a major power system emergency.

36527 (EPRI-EM—5806-Vol.2) Secondary data for demand-side management planning and implementation: Volume 2, Case studies: Final report. Limaye, D.R.; Burkey, M.B.; Davis, T.D. (Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA)). May 1988. 147p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011364/JAW.

Information on market characteristics is needed for effective planning and implementation of demand-side management (DSM) programs. A wide range of information can be obtained quickly and inexpensively from existing data sources. This report identifies the sources of secondary data, including federal, state and local government agencies, utilities, EPRI and various private organizations. The specific types of data available from these organizations and their applicability and usefulness in demand-side management, are reviewed. A PC-based software package, DATA-DSM, has been developed to assist the user in easily and quickly identifying the relevant secondary data sources. The Guidebook is organized in two volumes. The first volume provides a comprehensive listing of the data sources and software packages to assist market implementation planning, and provides a description and user guide for the DATA-DSM software package. The second volume provides the results for three illustrative utility case studies, and presents an illustrative example of the use of geographic mapping software to display secondary data. 48 figs., 22 tabs.

36528 (IIUG/dp—86-15) Small-scale power and electric utility regulation: Potential for reform. Bongaerts, J.C.; Kraemer, R.A. (Wissenschaftszentrum Berlin fuer Sozialforschung gGmbH (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1986. 49p. Wissenschaftszentrum Berlin fuer Sozialforschung g.G.m.b.H. (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft.

Current electric utility regulations invariably favour large-scale power production which necessitates long-distance transmission and prohibits the use of waste heat originating in the power plants. At the same time small-scale electricity generating technologies are available which have much higher total energy conversion rates, or do not burn fossile fuels. The relevant regulations of the Netherlands, the Federal Republic of Germany, and the United Kingdom, as analysed in the paper, restrict effective competition from these small-scale power producers and thereby protect existing electricity generating plants. A closer look at the economies of scale in this industry reveals that it might not constitute the optimal configuration and that customers might benefit from re-regulation. A certain capacity and generation potential for one small-scale generation technology (combined heat and power or co-generation) is found for different classes of customers which could be realised by regulatory reform. (orig./HSCH).

36529 (NEI-NO—34) Seminar on gas in Nordic energy supply. (Norsk Energiforening, Oslo). 1987. 222p. (In Norwegian). (CONF-8704287—). NTIS (US Sales Only), PC A10. Order Number DE88752839/JAW.

From Seminar on gas in Nordic energy supply; Oslo, Norway (8 Apr 1987).

The conference proceedings contain 11 papers. The topics covered are: Norwegian gas in Nordic energy supply; Thermal power in Swedish energy supply; Thermal power in Danish energy supply; Thermal power in Finnish energy supply; Perspectives on the application of Norwegian gas in the Nordic countries; The platform for natural gas in West Germany; Domestic use of gas; Gas technological development perspectives; Gas in the power production; Natural gas in Sweden - the experiences so far; Gas power - a challenge to the Norwegian industry. Separate abstracts were prepared for 7 papers of the proceedings.

36530 (NEI-NO—34, pp 18) **Norwegian gas in a Nordic energy context.** Oeyen, A. (Olje- og energidepartementet, Oslo). 1987. (In Norwegian). NTIS (US Sales Only), PC A10. Order Number DE88752839/JAW. (CONF-8704287—).

From Seminar on gas in Nordic energy supply; Oslo, Norway (8 Apr 1987).

Norway's export of natural gas is a little more than 25 billion m3 per year, and that is about 11% of the gas consumption in Western Europe. It is expected that the Norwegian gas production will be relatively stable the next two years. The export is assumed to reach a peak of ca 28 billion m3 in 1989. Recently great interest has been shown in Norway for gas in the Norwegian energy supply, both for electric qower production and direct application. An agreement has been reached between Statoil and Statkraft for sale of gas to a planned power plant on the west coast of Norway, based on natural gas from the North Sea. The agreement implies deliveries up to an amount of l billion m3 gas per year for 25 years from 199l. Of special interest for the Norwegian gas export is the Swedish market, which seems to have a considerable growth potential. Due to its geographical position, Haltenbanken appears as the perhaps most interesting region for energy export to Sweden. The export may be in the form of electricity (power plant in Norway) or as gas transported in a pipe. 4 figs.

36531 (NEI-NO—34, pp 23) **Thermal power in Swedish energy supply.** Sundell, J. (Statens Vattenfallsverk (Sweden)). 1987. (In Swedish). NTIS (US Sales Only), PC A10. Order Number DE88752839/JAW. (CONF-8704287—).

From Seminar on gas in Nordic energy supply; Oslo, Norway (8 Apr 1987).

The future of the natural gas in Sweden is strongly coupled to the electric power supply and the phasing out of nuclear power by the year 2010. In a short term perspective the Swedish natural gas market is estimated to 2.5 billion m3. It is reasonable that only a certain part of the nuclear electric power production will be replaced by an electric power production based on natural gas. With this assumption the Swedish natural gas market in the beginning of the next century will be of the order of 5-7 billion m3 per year. Potential suppliers of natural gas are Norway, the Soviet Union via Finland, and Denmark. 2 figs., 4 tables.

36532 (NEI-NO—34, pp 27) **Thermal power in Danish energy supply.** Guldborg, S. (Dansk Naturgas A/S, Denmark). 1987. (In Danish). NTIS (US Sales Only), PC A10. Order Number DE88752839/JAW. (CONF-8704287—).

From Seminar on gas in Nordic energy supply; Oslo, Norway (8 Apr 1987).

Based on a resolution in the Parliament in 1979, a high pressure natural gas system has been established in Denmark. In cooperation with the regional natural gas companies the gas has now been conveyed to practically all parts of the country. According to investigations in the North Sea, there are about 100 billion m3 proven reserves of natural gas, and a total amount of reserves of 240 billion m3. 20 figs.

36533 (NEI-NO—34, pp 12) **Perspectives on the application of Norwegian gas in the Nordic countries.** Ager-Hanssen, H. (Statoil, Stavanger (Norway)). 1987. (In Norwegian). NTIS (US Sales Only), PC A10. Order Number DE88752839/JAW. (CONF-8704287—).

From Seminar on gas in Nordic energy supply; Oslo, Norway (8 Apr 1987).

An outline is given of the development of the gas activity in Norway. In 1986 the total Norwegian production of natural gas was about 25 billion m3. A conservative estimate of the amount of Norwegian gas applied in the Nordic countries in the year 2000 is 10 billion m3, with 3 billion in Sweden, 2.5 billion in Denmark, 2 billion in Finland and 2.5 billion m3 in Norway. A more extensive estimate, which assumes that some of the nuclear power plants in Sweden have been phased out, results in the following figures for the year 2000: 9 billion m3 in Sweden, 3.5 billion in Denmark, 3 billion in Finland and 3.5 billion in Norway. 2 figs.

36534 (NEI-NO—34, pp 10) **Thermal power in Finnish energy supply.** Rantanen, J. (Neste Oy (Finland)). 1987. (In Swedish). NTIS (US Sales Only), PC A10. Order Number DE88752839/JAW. (CONF-8704287—).

From Seminar on gas in Nordic energy supply; Oslo, Norway (8 Apr 1987).

Among the Nordic countries, Finland is the one that has applied natural gas for the longest time. In 1974 Russian natural gas was introduced in the southeastern part of the country. According to an agreement with the Soviet Union, Finland is obliged to import 1.4 billion m3 natural gas per year until 1993. The natural gas is competitive as energy source both in industry and for heating in buildings. The greatest growth in application will be outside the industry, especially in the district heating. The consumption of natural gas is expected to increase to about 3 billion m3 per year towards the end of the 1990's.

36535 **(PB—88-179262/XAB) Demonstration of new submetering technologies. Final report.** Hirschfeld, H.E.; Stone, S.M. (Hirschfeld and Stone, Glen Cove, NY (USA)). Oct 1986. 133p. NTIS, PC A07/MF A01.

The project was designed to investigate submetering technologies and to assess their conservation impact, based on energy efficiency and economics. Four types of submetering systems were installed in separate multifamily residential housing complexes in New York City. Three of the systems are categorized as new submetering technologies and the fourth uses conventional electromechanical metering. The new types of systems are: (1) Electronic metering using carrier wave technology for communications; (2) Electronic metering using dedicated wiring for communication; and (3) Hybrid metering, combining an electromechanical-type communications system. The new systems were evaluated for performance and reliability and all of the systems were evaluated for economics.

36536 **(STU—80-4813) Capacity expansion planning for hydro-thermal electric power systems.** Nordlund, P. (Swedish National Board for Technical Development, Stockholm). Feb 1986. 149p. NTIS (US Sales Only), PC A07. Order Number TI88752971/JAW.

This report contains an overview of available expansion planning tools for electric power systems, and a proposition of a method that can be included in existing planning aids to improve the hydro power representation. The general formulation of the power system expansion planning problem is presented in section 2. Analysis and solution methods presented in section 3 include Production Costing, Linear and Dynamic programming, Benders' Decomposition and Decision Analysis. Two widely spread program packages, WASP (Wien Automatic System Planning package) and EGEAS (Electric Generation Expansion Analysis System) are presented in sections 4 and 5. In sections 6 and 7 some specific hydro related analysis methods are discussed, concerning production costing and storage modeling. An overall methodology suggestion for hydro modeling improvement in existing planning packages is presented in section 8. Finally, a simple application example is presented in section 9. With 35 refs.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 35680, 36477

36537 **Energy consumption and structure of the US residential sector: Changes between 1970 and 1985.** Meyers, S. (Energy Analysis Program, Lawrence Berkeley Lab., Berkeley, CA 94720 (US)). pp 81-98 of Annual review of energy: Volume 12. Hollander, J.M. Palo Alto, CA; Annual Reviews Inc. (1987).

Between 1970 and 1985 the number of homes in the United States increased by 35%, and the average home became more appliance-intensive. Yet primary energy demand of the residential sector was only 17% higher than in 1970, and "useful" energy demand (i.e. excluding transformation losses in power plants and home furnaces) was only 5% higher. On a per capita basis, primary energy demand, which grew by 57% between 1960 and 1973, was 8% less in 1985 than in the peak year of 1973. Useful energy demand per

capita was 16% less. Demand per household declined even more, as the average household became smaller and thus had gradually less demand for energy services. The increase in the demand for services, which arose from more households, each with more appliances, was balanced by a decrease in the energy demand associated with each service. This decrease in energy intensity has been shaped by responses to higher energy costs and by technological change. The changes in residential energy demand are outgrowths of structural changes in the physical setting (geographic distribution of the population, household characteristics, and the state of buildings and their energy-using equipment), along with behavioral changes (people's amount of time at home and their behavior in the home). The structural features and behavior are in turn shaped by the economic setting, the institutional setting (i.e. the orientation of governments, energy suppliers, and equipment manufacturers), demographic changes, and the social psychological setting that influences household energy-related decisions and behavior. This article reviews the changes since 1970 in US residential energy consumption and in the structure of the household sector. The main sources for data at the national level are statistics gathered by various federal agencies, especially the Energy Information Administration of the US Department of Energy.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 35954, 35955, 35995, 35996, 36032, 36033, 36479

36538 (BFR-R—85-1986) Cold district heating using groundwater in Timraa. A feasibility study. Gedda, C.; Jonsson, R. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 23p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752892/JAW.

The objective of this work has been to investigate the feasibility of supplying heat to buildings by means of a cold water distribution system, from which heat would be abstracted at the point of use by heat pumps. The cold water could be abstracted from the old underground esker aquifer of the Indal river, a groundwater flow system that is unique in Sweden. However, the feasibility study indicates that the costs would be too high in the light of present-day energy prices and the size of the potential load. The system might, however, become feasible if there was new development in the area, allowing cold water to be distributed for individual heating of buildings. A necessary requirement for use of this method is that the distribution system should be compact, or that the heat load density within the area should be high, i e that of an urban area.(authors).

36539 (BFR-R—91-1986) River water as a heat source. Jelbring, H. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 28p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752896/JAW.

The heat pump installation in Kaunisjoensuu customs post has been in operation now for two seasons. During this time, virtually all the heating power and energy has been supplied by the heat pump. The pump has abstracted heat from the Muonio river, which is covered with ice for six months of the year, through a hose heat exchanger. During the winter, about 60 percent of the necessary energy has been obtained by heat exchange of sensible heat, and 40 percent as the latent heat of freezing, with ice gradually building up round the heat exchanger so that, by the end of the heating season, the total volume of ice amounts to about 200 m/sb2/. The Kaunisjoensuu heat pump installation demonstrates the practical and general feasibility of using water as a heat source, irrespective of its temperature. The specific design load rating of a hose heat exchanger for laying in a river should lie between 6 - 15 W/m. The report describes the advantages and disadvantages of the particular design of heat exchanger used here. A number of technical novelties intended to achieve a good coefficient of performance have been successfully tested. The amount of purchased energy per heated square meter and year has amounted to 88 kWh for the 1982/83 heating season. Translated to the corresponding needs of an installation on the latitude of Stockholm, this would be equivalent to 57 kWh per m/sb2/ and year. The heat pump installation in Kaunisjoensuu therefore constitutes a good example of what can be achieved with a properly designed system. Nevertheless, it would be possible to improve on the system, and both The Swedish Council for Building Research and the author hope that this report can contribute to an improved insight into the feasibility and limitations of the method, particularly with respect to the potential of Swedish rivers as energy resources.

36540 (KTM/E-D—136) Use, production and competitiveness of wood chips as a fuel - According to the Finnish forest development programme "Forest 2000". Vitikka, A. (Kauppa- ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 66p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752824/JAW.

This report describes the use, production and competitiveness of wood chips as a fuel. The harvesting potential of wood chips as a fuel is also presented regarding the Finnish forest development programme "Forest 2000". As a district heating fuel wood chips were used about 750 GWh and in industrial power plants about 400 GWh in 1985. The small-scale use of wood chips - mainly in farms - was also about 400 GWh in 1985. Of the total technical capacity to utilize wood chips 30% was used in district heating and 10% in industrial power plants in 1985. The main commercial suppliers of wood chips in Finland are Vapo Oy and Osuuskunta Metsaeliitto. At the moment the most economical way of supplying wood chips is to make whole tree chips. Wood chips made that way can be transported to a site at a price of FIM 50-60/MWh under favourable harvesting conditions. At a current price of crude oil wood chips cannot compete with heavy fuel oil in district heating and with sod peat wood chips can compete only if subsidized. As a fuel industrial power plants the competitiveness of wood chips is also relatively week and has further weakened during 1986. The use of wood chips as a fuel can increase notably only if the prices of imported fuels rise.

36541 (NEI-DK—77) Utilization of wind energy resources in Naqu, Tibet. (Energistyrelsen, Copenhagen (Denmark)). Jan 1986. 176p. NTIS (US Sales Only), PC A09. Order Number DE88753332/JAW.

The first part of this report contains descriptions of the background for a study performed by a Danish delegation of energy experts, concerning the possibilities to utilize wind energy resources in the Prefecture of Naqu in Tibet, China. The Danish delegation was invited to make a fact finding mission in September 1985 to Tibet in order to obtain information about wind conditions, the existing energy supply system and demand patterns and the actual plans for economic and social development in Naqu Prefecture. Descriptions are given of the Windmill Test Station in Naqu, the Meteorological Station in Naqu and wind data at this last station. Information of a primarily selected site for windmills (Digema Hill) and other possible sites follows. Many energy developments in Naqu are possible, and some elements in such developments are described, with special attention to wind power plant, potential electricity consumption in the industrial and the domestic sector and the public electrical network. The third part includes finally some further considerations on future possible improvements of the energy supply system in Naqu: A tentative programme for establishing a 450 kW wind power capacity, development of a distribution system for heat (hot water) in Naqu and a sketch of an alternative concept for a wind energy village. Conclusions are formulated as four sets of recommendations directed to the Energy Leading Group in Tibet. Wind energy is only a part of the potential energy supply options. Thus decisions on wind energy should be seen as a part of strategy for the development of the total energy sector. Consisting of energy demand, supply systems are energy resources. (EG).

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 38321

36542 (AD-A—190307/9/XAB) Fundamental studies on MPD thrusters. Final progress report, April 1985-December 1986. Lawless, J.L. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering). 2 Sep 1987. 258p. (—1-52097). NTIS, PC A12/MF A01.

A theory was developed that predicts onset and erosion in MPD thrusters. The theory predicts onset currents that are in quantitative agreement with experiment. Erosion rates are predicted for a steady-state hot-cathode thruster. This theory is the first to model the viscous and thermal-electrode boundary layers in MPD thrusters. Stability criteria for diffuse-mode electrode current conduction were found.

36543 (AD-A—190309/5/XAB) Physical fluid mechanics in MPD thrusters. Annual report, 1 May 1986-30 April 1987. Martinez-Sanchez, M. (Massachusetts Inst. of Tech., Cambridge (USA). Space Systems Lab.). 18 Sep 1987. 53p. NTIS, PC A04/MF A01.

This report describes work done on three areas of MPD research: (a) a rigorous theoretical examination of the one-dimensional flow of a self-field accelerated plasma, clarifying the roles of area change, sonic vs. magnetoacoustic shocking, and finite magnetic Reynolds number. (b) continued development of computational codes for axisymmetric MPD flows, and (c) results of a first test series on two channels designed to verify productions on the effects of area variation, showing ability to redistribute current by this means.

36544 (CONF-880647—1) Materials tests in support of MHD steam bottoming plant. Natesan, K.; Swift, W.M. (Argonne National Lab., IL (USA)). May 1988. Contract W-31-109-ENG-38. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012040/JAW.

From 26. symposium on engineering aspects of magnetohydrodynamics; Nashville, TN, USA (20 Jun 1988).

Test data have been developed for the corrosion of several commercial ASME-coded alloys and their weldments by exposing internally cooled ring specimens to simulated MHD environments. The specimens, coated with a K_2SO_4-rich deposit, were exposed for times up to 2000 h at metal temperatures of 762 and 593°C to simulate intermediate-temperature air heater (ITAH) and transition region conditions, respectively. The gas temperatures in these tests were 982 and 816°C, respectively. This paper discusses, in detail, the observed corrosion scale morphologies of various exposed specimens. Data on scale thickness, depth of intergranular penetration, and metal recession are presented and the results are used to assess the corrosion behavior of various materials for application in the MHD steam bottoming plant.

36545 (LTKK-EN—D-12) Regulation properties of a system MHD generator - electric power network. Krzysztof D. (Lappeenrannan Teknillinen Korkeakoulu (Finland). Energiatekniikan Laitos). 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752830/JAW.

In this report several problems connected with the mutural operation of MHD generator and electric power network are described, i.e. regulation properties of the MHD-generator, optimal matching of the MHD-generator and converters, current regulation in transient states. The results for transient states caused by mass flow rate and stagnation temperature drop at the MHD-generator duct inlet are also presented.

3004 Thermionic Converters

36546 Thermionic characteristics of planar and cylindrical oxygen additive tungsten-niobium diodes. Hatch, G.L.; Korringa, M.; Sahines, T.P. (Rasor Associates, Inc., Sunnyvale, CA (US)). pp 2007-2010 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879125.

As a part of the ongoing Thermionic Technology Program, a test matrix of both cylindrical and variable spacing planar thermionic diodes has been designed to establish a generic data base over the range of emitter and collector temperatures, electrode spacings, and electrode materials of significance for thermionic fuel element (TFE) application. The converters were fabricated at Thermo Electron and performance mapped at Rasor Associates. Emitter surfaces tested are both CVD tungsten WF_6(100) and WCL_6(110) crystal orientations, while the collector surfaces are plain niobium or sublimed molybdenum oxide coating on niobium substrate. The results from the test matrix can be used to establish the optimum collector oxide layer and emitter surface crystal orientation for a variety of applications besides the TFE program since oxide collector layers and emitter surface crystal orientation can significantly improve converter performance at large spacings and high current densities. The electrical properties of diodes with the same electrode surface combinations in both planar and cylindrical geometries are measured to establish the applicability of data from variable spacing planar diodes to the engineering design of optimized cylindrical TFE cells and prediction of their efficiency. The wide parametric range of diode performance measurements includes data, not available prior to this work, useful for an understanding of plasma and plasma-electrode processes in thermionic convertors.

3005 Fuel Cells

36547 (CONF-880665—4) Monolithic fuel cells. McPheeters, C.C.; Balachandran, U.; Dees, D.W.; Dorris, S.E.; Heiberger, J.J.; Mrazek, F.C.; Myles, K.M.; Picciolo, J.J.; Poeppel, R.B. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012004/JAW.

From 33. international power source symposium; Cherry Hill, NJ, USA (13 Jun 1988).

Recent work on the MSOFC (Monolithic Solid Oxide Fuel Cell) has resulted in the following accomplishments: (1) the feasibility of the MSOFC concept has been proven, (2) the fabrication processes have advanced to the point of production of near defect-free fuel cell stacks, (3) the electrode characteristics have been significantly improved to enhance MSOFC performance, (4) single-cell performance has been demonstrated at very high current densities, and (5) multi-cell stack performance has improved significantly in terms of both higher open-circuit potential and lower cell resistance. The objectives of further development are to scale up the MSOFC in terms of power level, active area, and stack height. Scale-up to significant power levels (above 1 kw) will involve development in several areas including manifolding, insulation, gas handling and control, electrical contacts, and power control.

36548 (DOE/FE—0105) Fuel cell systems program plan: FY 1988. (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Oil, Gas, Shale and Special Technologies). May 1988. 43p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011080/JAW.

The DOE fuel cell program supports high-risk, high-payoff technology development. This provides industry with the capability to develop and apply fuel cell systems that use conventional and alternative hydrocarbon fuels. The principal DOE fuel cell program goal is to develop cost effective, efficient, and environmentally benign fuel cell systems which will operate on coal-based fuels (and dual fuels: coal and gas) in multiple end use sectors. In the near-term, and as an interim step in achieving this goal, distillate

fuel and natural fuel cell system technologies will also be developed. This interim step is a logical progression to the more complex coal-fueled systems and provides a marketable gas-fueled technology. The specific near- to mid-term (mid-1990s) objectives are to develop the key fuel cell technology for phosphoric acid, molten carbonate, and solid oxide fuel cell systems, and to evaluate and conduct research on more advanced fuel cell concepts that would further improve technical and economic performance. Advanced fuel cell concepts may in the long-term (post 2000) offer potential for use in additional applications such as in the transportation and residential sectors. In these applications oil could be displaced by fuel cell systems using fuels derived from coal.

36549 **(DOE/FE/60338—2557) Phosphoric acid electric utility fuel cell technology development: Technical progress report No. 33, for quarter ending October 31, 1987.** (International Fuel Cells Corp., South Windsor, CT (USA)). 1987. Contract AC21-83FE60338. 10p. (FCR—9206). NTIS, PC A03;3. Order Number DE88010187/JAW.

The Department of Energy has initiated this program to advance phosphoric acid electric utility cell stack technology and to reduce cell stack cost. The cell stack has a nominal 10-ft² active area and operates at 120 psia405{degree}F. The program comprises six parallel phases, which culminate in a full-height, 10-ft² stack verification test. The only active technical task under this program is Phase VI, Task 5—Operational Testing. The objective of this task is to conduct additional testing of the full-height 10-ft² stack with a goal of reaching 3500 hours.

36550 **(LBL—24340) Oxygen reduction in fuel cell electrolytes.** Striebel, K.A.; McLarnon, F.R.; Cairns, E.J. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 244p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88008240/JAW.

Experimental and theoretical studies of oxygen reduction (OR) in novel acid and alkaline electrolytes on smooth and supported Pt have been carried out. Similar kinetically limited rates for OR were measured in the {open←quotes}super-acid{close←quotes} electrolytes trifluoromethane sulfonic acid (TFMSA) and tetrafluoroethane-1,2-disulfonic acid (TFEDSA), with the rotating disk electrode (RDE) technique at 23{degree}C and pH = 1. A first-order dependence on O_2 pressure was measured. The mechanism for OR on Pt in alkaline electrolytes is complicated by the concurrent oxidation and reduction of Pt. Rotating ring-disk electrode (RRDE) studies carried out with anodic and cathodic potential sweeps in 0.1 to 6.9 M KOH and 0.1 to 4.0 M K_2CO_3 revealed similar currents when corrected for O_2 solubility differences. In dilute electrolytes, OR proceeds primarily through the 4-electron pathway to water, independent of pH. In KOH, the mechanism for Pt oxidation changes and the fraction of current yielding a peroxide product increases at 2 to 3 M. These changes were not observed in K_2CO_3. Porous gas diffusion electrodes (GDE) with supported Pt catalyst were studied in a special cell with low uncompensated solution resistance. Cyclic voltammograms yielded measurements of the wetted areas of carbon and Pt and the local electrolyte composition. GDE galvanostatic steady-state performance with 100% O_2 was measured in 2 to 11 M KOH and 2 to 5.5 M K_2CO_3. Results suggest that OR on carbon contributes to the high currents in 6.9 M KOH at high overpotentials. In K_2CO_3, lower wetted areas and slow OH/sup {minus/} ion transport are responsible for the poor performance when compared with KOH. Models for the steady-state operation of porous GDE's were developed. These models account for the diffusion and reaction of O_2 and ionic transport in KOH and K_2CO_3. 120 refs., 71 figs., 11 tabs.

36551 **(PB—88-203161/XAB) Production and characterization of non-platinum catalytic materials formed by ion implantation. Annual report, November 1, 1986-October 31, 1987.** Greenwald, A.C. (Spire Corp., Bedford, MA (USA)). Dec 1987. 23p. (AR—20342-01). NTIS, PC A03/MF A01.

Catalytic activity for oxygen-ion production in a phosphoric acid fuel cell was observed with electrodes prepared with nitrogen ion-implanted carbon blacks. These electrodes were prepared without the addition of any metals, and especially without platinum. Comparisons to electrodes prepared with platinum and metal-ion implants is presented. Methods of preparation and measurement are discussed.

36552 **Internal electrolyte supply system for reliable transport throughout fuel cell stacks.** Wright, M.K.; Downs, R.E.; King, R.B. (to Dept. of Energy, Washington, DC). US Patent 4,732,822. 22 Mar 1988. Filed date 10 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In a fuel cell stack having electrolyte feed and drain means and stacked fuel cells, each fuel cell including bipolar plates separating the fuel cell from adjacent fuel cells in the stack thereof and an electrolyte-containing matrix disposed between the plates, and improved internal electrolyte supply system interconnecting the feed and drain means is described comprising: (a) first means defined repeatedly throughout the fuel cell stack for flowing electrolyte along a series of first paths each extending directly through at least one cell between the plates thereof so as to expose electrolyte to the matrix of the cell; and (b) second means defined repeatedly throughout the fuel cell stack for flowing electrolyte along a series of second paths extending through the plates of the cell stack and by-passing respective ones of the first paths so as to supply electrolyte directly to respective others of the first paths without first going through the ones of the first paths.

3008 Miscellaneous Converters

36553 **(DOE/CE/15218—T1) Hydrogen concentration cells as converters of heat into electricity: Final report [for the period ending September 30, 1987].** Salomon, R.E. (Temple Univ., Philadelphia, PA (USA). Dept. of Chemistry). Oct 1987. Contract FG01-85CE15218. 50p. NTIS, PC A03 . Order Number DE88009662/JAW.

The properties of the platinum coated Nafion hydrogen pressure cell have been determined over a range of conditions and as a function of the variable parameters associated with the preparation of this cell. Other protonically conducting membrane cells have been prepared with both commercially available membranes and membranes synthesized in our laboratory but we have been unable to find any membrane, which works better in the application described here, than Nafion. Two different Nafion membranes have been utilized in this work (125 and 117) and the differences between them were negligible. Accordingly, the bulk of this report will deal with the platinum coated Nafion hydrogen pressure cell. As part of our efforts to enhance cell conductance, solution composition was varied as was time of contact with the platinizing solution. The efficacy of multiple coatings was also analyzed. Other metals were tried as electrocatalysts as were other methods of reduction (hydrazine and molecular hydrogen) in place of our main reducing agent, sodium borohydride. Various cell configurations were designed, built and tested and as a result of this we have determined that high pressure contacts are most desirable. We have determined the pressure and temperature dependence of these cells and in the course of this have found a super-Nernstian cell behavior which has both practical and theoretical significance for this invention. Two concentration cell systems have been assembled and tested for some periods of time and the results suggest that the two concentration cell converter may be most useful when the low temperature is subambient and the high temperature heat source is at ambient.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 36464

36554 **(DOE/CE—0200) Annual report to the President and the Congress on the State Energy Conservation Program for calendar year 1986.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Energy Management and Extension). Oct 1987. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006896/JAW.

This volume briefly reviews state participation in the State Energy Conservation Program during 1986. Appropriations and grants are listed. (JDH)

36555 (TKK-KO/LVI—B15) Effect of HVAC-systems on the energy management. Roos, R. (Helsinki Univ. of Technology, Otaniemi (Finland)). 1987. 105p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752863/JAW.

This study is concentrated on four states in the U.S. (Iowa, Michigan, Minnesota and Wisconsin) and Finland. The study consists of five main chapters. These are: factors effecting on the HVAC-technical decisions; typical HVAC systems in the U.S.; flexibility, technical properties and energy efficiency of typical conventional HVAC systems in the U.S.; new HVAC systems and equipment and electricity consumption peak levelling. Most important factors effecting on the HVAC-technical decisions are: climate, primary energy sources, construction industry, community structure, and various standards and codes. Climate in Finland and in the studied states is not similar. The "continental" climate in the U.S. has caused some typical featres in the HVAC systems used. Some of these are: In the hot summer season cooling is needed, Usually this is provided by cold air, and In the cold season warm air is used for space heating.

3201 Buildings

REFER ALSO TO CITATION(S) 36032, 36033, 36035, 36045, 36456, 36459, 36510, 36511, 36537, 36538, 36539, 36646, 36673, 36686, 36687, 36688, 36722, 37305, 37400, 37403, 37670

36556 (BFR-R—39-1986) Heat pumps using air as their heat source. Defrosting methods. Fehrm, M. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 8 Dec 1985. 46p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752881/JAW.

The objective of this work has been to describe the various methods used for defrosting air heat pickup coils for heat pumps, and to describe the methods used for starting and stopping defrosting. The report describes a number of different principles and methods of starting, carrying out and stopping defrosting. Most of this information has been drawn from literature such as research reports and technical articles. Defrosting can be initiated by comparing the temperature or pressure to drop on the air or refrigerant sides. Other methods involving electrical or optical detection also exist. In some cases, defrosting is initiated purely under time control. Similar methods can be used to stop defrosting. Frost is generally removed by supplying heat either via the refrigerant, through the cooling agent, by air, by electric heaters among the heat pickup coils or by radiant heat, with mechanical scraping being used in one case. The report describes various methods of defrosting, and of inhibiting the formation of frost or improving the efficacy of defrosting. It has not been possible to include a qualitative comparison between the various methods, as the source material was too sparse to permit such comparison. With 19 refs.

36557 (BFR-R—66-1986) Hall-buildings with dynamic insulation. Present state of development. Thoren, T. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 31p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752885/JAW.

Today, the new insulation technique, dynamic insulation, has been adapted in a simplified type of roof (produced without the special air pressure layer that the author has found necessary for good performance) in hundreds of hall buildings in Sweden. (With hall-buildings means different non-residential buildings, such as shopping centers, factories, offices etc). Outside Sweden, mainly in Finland, about one million squ. meters of hallbuildings have been built since 1975 with principally the same type of simplified counterflow roofs. In some cases, these roofs have shown deficiencies, which, however, can be eliminated by new technical solutions. The theoretical base for the technique is to-day documented in inter alia different reports by the Swedish Council for Building Research. The gap between theory and advanced serial production has, however, not been systematically worked up. The intention of this report is to fill this gap to some extent. The report also gives some alternatives for the future development towards a commercial serial production. The author, who also is the inventor of this technique, has worked out different practical solutions for these alternatives.

36558 (BFR-R—72-1986) Rock heat installation with 80 KW heating power capacity. Performance monitoring of a rock heat installation consisting of seven boreholes and heat transfer medium in a closed circuit. Tollin, J.; Aabyhammar, T. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 45p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88752888/JAW.

A rock heat installation with a nominal output of 80 kW was constructed during the spring of 1983 to supply heat to a property having a normal oil consumption of 70 m/sp3/ per year. The property, which consists of two apartment buildings, is in Taeby. The rock heat collector consists of seven 150 mm diameter boreholes, drilled to a depth of 150 m. The report describes the prerequisites and experience relating to design, rating and installation of the rock heat collector. It describes both the design of the boreholes and of the heat transfer medium system. Apart from certain interruptions, system performance measurements have been made over a continuous period of three years. The results from the measurements are included in the report. Summarizing, it can be said that the installation has provided the expected saving in oil consumption of 55 m/sp3/ per year, in spite of considerable control problems. The calculated borehole temperatures agree with the as-measured temperatures.

36559 (BFR-R—94-1986) Experimental day nursery. Selection of systems and materials. Hult, M. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 109p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752898/JAW.

The aim of this project was to build a day nursery whose structure building materials, heating system, ventilation, controling and regulating equipment and lighting would combine to produce a good indoor climate. The present report describes the specification of requirements underlying the design of the experimental day nursery, as regards the thermal and hygienic climate. This specification elucidates and discusses experience of climatic problems and day nursery production in the City of Stockholm. Guidelines are laid down concerning the following aspects of day nursery design: floor temperature, room temperature, air humidity, air pollutants, supply air quality, air flow, ventilation efficiency and operational dependability/maintenance. The report ends with a description of the design of the day nursery, the materials selected for it and the built-in experimental facilities for heating and ventilation. The day nursery is being erected on a site in Molntappen precinct (at Skarpnaecksfaeltet, southeast of Stockholm). It is due for completion in December 1986, after which it will be evaluated over a threeyear period. 31 refs.

36560 (BFR-R—98-1986) Climatic prerequisites for air curtain portals. Taesler, R. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 59p. (In Swedish). NTIS (US Sales Only), PC A04. Order Number DE88752901/JAW.

This report deals first with the basic conditions of importance for effective performance and low energy losses of air curtain portals. It then describes examples of specially developed statistics illustrating the effects of variations of wind direction, wind velocity and ambient temperature. Calculations of average nominal energy loss through an open doorway without an aircurtain have been made on the basis of observations over the period from 1955 to 1975 for various places throughout the country. This is followed by description and results of measurements of local and building-related effects on wind and temperature conditions for a particular installation in Linkoeping. Wind conditions in particular exhibit considerable changes due to the local environment directly resulting from the surrounding building structure. The work has been carried out by the Swedish Meteorological and Hydrological Institute, together with AB Bahco Ventilation and the Department of Heating and Ventilating at the Royal Institute of Technology in Stockholm, as a part of larger project for investigating energy conservation resulting from the use of air curtain portals.

36561 **(BFR-R—113-1986) Energy conservation town block at Uppsala.** Bjerkling, S.E. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 122p. (In Swedish). NTIS (US Sales Only), PC A06. Order Number DE88752907/JAW.

On selected housing estates at six locations in Sweden: Malmoe, Goeteborg, Sundbyberg, Uppsala, Umeaa and Kiruna, energy conservation measures were planned and implemented with the object of finding the savings effect and cost effectiveness of each of these measures. This project sets out the results obtained on the housing estate Rangstroem 2 at Uppsala. The report is introduced by general information concerning the buildings, preliminary investigations and planned measures. This is followed by energy calculation models, observations concerning the energy conservation measures, measurement results and evaluations. The report is concluded by instructions for running these residential buildings which had been drawn up and put into practice. In the two stages concerned, the following results were obtained with regard to energy savings and the cost of the measures, in relation to the reference building. Stage 1, Weather proofing of external walls and windows. Alteration of ventilation installation 25 percent SEK 84.3 per m/sp2/ net floor area. Stage 2, Conversion of ventilation in underfloor space from fresh air to indoor air ventilation, 30 percent SEK 32.9 per m/sp2/ net floor area. Balancing of heating system. Conversion of windows (1 building) 40 percent SEK 66.8 per m/sp2/ net floor area. The report also contains information concerning the experiences obtained in relation to the remedial measures, the attitude of the tenants to the remedial works, the way the instructions for running the buildings have worked, etc.

36562 **(BSRIA-TN—5/87) Ice storage for UK air conditioning systems.** Stewart, L.J. (Building Services Research and Information Association, Bracknell (UK)). Sep 1987. 16p. Building Services Research and Information Association, Old Bracknell Lane West, Bracknell, Berks. RG12 4AH, price Pound 15.00.

The technical developments and trends in the application of ice storage techniques are reviewed based on published information, primarily from the USA, and the case for the application of ice storage on the UK air conditioning scene is considered. There is case study information now available that indicates that ice storage systems can lower the overall costs of central station air conditioning systems by using lower operating temperatures when cooling. Not only does storage reduce the chiller system capacity requirement but the lower temperatures available can reduce the size of the air and water distribution systems. If lower capital costs can be confirmed for ice storage systems then this will be the stimulus to the adoption of these systems in the UK.

36563 **(CONF-871203—3) A comparison of two independent techniques for the determination of in-situ thermal performance.** Courville, G.E.; Desjarlais, A.O.; Tye, R.P.; McIntyre, C.R. (Oak Ridge National Lab., TN (USA); Dynatech Scientific, Inc., Cambridge, MA (USA); Koppers Co., Inc., Monroeville, PA (USA)). 1987. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009704/JAW.

From Conference on insulation materials, testing and applications; Bal Harbour, FL, USA (6 Dec 1987).

A parallel experiment has been performed on an insulated roof system installed in the Roof Thermal Research Apparatus (RTRA) at Oak Ridge National Laboratory (ORNL). Separate sections of a 4 foot, by 8 foot test panel were evaluated for over 12 months using two different heat flux transducer (HFT) instrumentation packages with the data being treated independently. The paper discusses the instrumentation packages, sensor calibration procedures, and data collection and analysis methods highlighting the differences between the independent techniques. A comparison of the independently derived thermal performance results is presented. The comparison includes a discussion of these types of HFT test techniques for determining the in-situ thermal performance of insulated building components. Limitations of these procedures are also detailed.

36564 **(CONF-880702—13) Magnetic heat pumps.** Hull, J.R.; Uherka, K.L. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012058/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Magnetic heat pumps and refrigerators are potential replacements for vapor-compression devices that use chlorofluorocarbon refrigerants. Several room-temperature designs, using low-temperature superconducting magnets, have reached the experimental device stage. High-temperature superconducting materials may significantly increase the viability of the technology, both by enhancing existing design concepts and by enabling new major design types such as field switching of the superconducting magnets.

36565 **(CONF-8804120—1) Impact of color on the thermal performance of roofs.** Shipp, P.H.; Griggs, E.I. (Oak Ridge National Lab., TN (USA); Tennessee Technological Univ., Cookeville (USA). Dept. of Mechanical Engineering). 1988. 23p. (CONF-8804120—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009713/JAW.

From American Chemical Society's Rubber Division meeting; Dallas, TX, USA (20 Apr 1988).

The number of roofing products available to architects and building owners has expanded greatly in the past decade. Roofs can now be specified in a variety of colors with the selection being based upon both the aesthetic effect and the potential energy savings which can accrue from different surface reflectance properties. The use of light versus dark colors can significantly affect the range of temperatures to which the membrane is subjected. This can impact both the energy performance of the building and the aging characteristics of the membrane, adhesives and other roof system components. Factors affecting the thermal performance of light and dark colored roofs are discussed and a procedure for predicting the temperature response of the roof membrane in various climates is presented.

36566 **(CRIE-U—86055) Heating and cooling performance of air-to-air heat pumps installed in the greenhouses with vegetables growth.** Kozakai, Kazuyoshi; Uehara, Tsuyoshi; Okano, Toshiaki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1987. 29p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752534/JAW.

Two units of integral-type air-air heat pumps (rated capacity: 7.5 KW each) and a heat storage type air-air heat pump (rated capacity: 7.5 KW) equipped with a heat storage water tank were installed in the experimental greenhouses (315 m^3 and 126 m^3) to introduced the heat pump as part of the development of power demand for the greenhouse culture. The experiment of hydroponic culture of tomatos in both summer and winter and merons in summer was made controlling the temperature and humidity in the greenhouse. The coefficient of performance (COP) of the integral-type air-air heat pump was 2.2 to 2.3 in the cooling season and 2.3 to 2.6 in the heating season. The crop of tomato per 10 areas was 11.6 tons in summer and 14.2 tons in winter and both crops were more than the mean valve in the greenhouse culture. The COP of the heat storage type air-air heat pump was 2.2 in the cooling season and 2.6 in the heating season. The average weight of a melon was 1.7 kg and the sugar content was approximately 13%. The crop and quality of melon exceeded the levels in the greenhouse culture. (14 figs, 8 tabs, 7 refs)

36567 **(DOE/CE/15324—T4) Component: dimmers, commercial: [Final technical progress report, February 1, 1988-April 30, 1988].** (Underwriters Labs., Inc., Research Triangle Park, NC (USA); Varigas Research, Inc., Timonium, MD (USA); Etalon Corp., Timonium, MD (USA)). 20 Apr 1988. Contract FG01-87CE15324. 23p. Underwriters Laboratories Inc., 12 Laboratory Dr., P.O. Box 13995, Research Triangle Park, NC 27709. Order Number TI88008781/JAW.

This paper contains a detail description and safety testing a two-wire v-controller by underwriters laboratories. (DLC)

36568 **(DOE/CE/63424—T1) Low income energy programs at mid-decade: limits and opportunities: Final report.** (Economic Opportunity Research Inst., Arlington, VA (USA); Grier Partnership, Bethesda, MD (USA)). 12 Jun 1986. Contract FG01-85CE63424. 348p. NTIS, PC A15;3. Order Number DE88011596/JAW.

A questionnaire was developed to survey the states and compile for the first time comprehensive data on the fuel assistance activities and weatherization activities at the state level. A major concern was to identify all sources of funds for energy conservation and fuel assistance as well as to determine the scope of the programs nationwide. Information collected through the questionnaire and other sources of data on the programs available at the national level were reviewed. A further activity was the development of a profile of the eligible and recipient populations for the Low Income Home Energy Assistance Program. This is a comprehensive presentation of the resources and types of programs that are available to assist low income persons with their energy burdens. It also contains findings that demonstrate the weaknesses and strengths of those programs and policy recommendations that address them.

36569 **(DOE/CE/63502—T3-Pt.1) Energy-efficient manufactured housing in Chicago: Part 1, Industry assessment and business concept paper.** (Center for Neighborhood Technology, Chicago, IL (USA)). [1986]. Contract FG01-86CE63502. 87p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88009614/JAW.

The Center for Neighborhood Technology (CNT) is exploring the feasibility of manufactured housing in the City of Chicago. This preliminary analysis focusses on the potential for establishing a manufactured housing plant in Chicago from two perspectives: as an economic development and job creation venture, as well as a possible element in meeting the Chicago area's needs for affordable housing.

36570 **(DOE/CE/63502—T3-Pt.2) Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues.** Rangelov, L. (Illinois Univ., Chicago (USA). Energy Resources Center). Dec 1986. Contract FG01-86CE63502. 87p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88009616/JAW.

The Center for Neighborhood Technology (CNT) with funding from federal and state sources is involved in a broad study examining the many economic and social issues of deteriorating neighborhoods. This study is a portion of the major study, conducted by CNT, which will specifically focus on the adaptability of manufactured housing for the City of Chicago. Specifically, this report focuses on: building codes regulating the construction of manufactured housing; manufactured housing construction process; current energy efficiency of manufactured housing; and Illinois manufacturers. Major conclusions of this report are: manufactured housing, with some changes in the construction process, can comply to the City of Chicago Building Code; and a high level of energy efficiency can be achieved in manufactured housing because of the controlled environment inherent in the construction of manufactured housing, because efficient products and techniques can be easily incorporated.

36571 **(DOE/CE/63502—T3-Pt.3) Energy-efficient manufactured housing in Chicago: Part 3, Building code and energy efficiency appendices.** Rangelov, L. (Illinois Univ., Chicago (USA). Energy Resources Center). Dec 1986. Contract FG01-86CE63502. 165p. NTIS, PC A08;3. Order Number DE88009615/JAW.

Rules and laws governing manufactured housing and mobile homes in Chicago, Illinois are documented. (BCS)

36572 **(DOE/CE/63502—T4) Feasibility analysis/business plan for proposed residential balancing venture.** (Center for Neighborhood Technology, Chicago, IL (USA)). 24 Dec 1986. Contract FG01-86CE63502. 127p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88009613/JAW.

To assess the feasibility of a residential balancing venture, Charles Rial and Associates determined the market potential for such a service, reviewed the efforts of the Chicago Energy Savers Fund, and interviewed engineering firms and heating and boiler contractors. Based on our findings, it was determined that a stand-alone venture that offers balancing as its only service will not reach a broad enough market to support a break-even operation, and therefore, does not represent a feasible venture opportunity. A more feasible approach would involve a joint-venture between an established heating/boiler contractor and a cbo. A summary of the findings that led to this conclusion are included.

36573 **(DOE/CE/63521—T1) Partnerships in Low-Income Residential Retrofit (PILIRR): Partnership model for the weatherization of low-income, multi-family housing.** Hunter, D.; Yasutake, B. (Washington State Dept. of Community Development, Olympia (USA). Div. for Community Services). Apr 1988. Contract FG01-86CE63521. 208p. NTIS, PC A10;3. Order Number DE88009667/JAW.

This report presents the nature, procedures, and product of the Washington State Partnership in Low-Income Residential Retrofit (PILIRR) Project (the Project). The Washington State Department of Community Development (DCD) was named one of five recipients, nationwide, of funds for the US Department of Energy (DOE) Partnerships in Low-Income Residential Retrofit (PILIRR) project. In August, 1987, DCD proposed to research and demonstrate the leveraging of public and private resources to weatherize low-income multi-family housing. This Partnership Model (the Model) is the final product of the Project. Designed as a resource guide, the Model will will be used by weatherization contractors [i.e., Community Action Programs (CAPs)] to assist in leveraging activities. Included are examples of successful partnerships, a collection of possible funding sources, marketing tips, and a promotional brochure.

36574 **(DOE/CH/10248—2) Weatherization assistance program monitoring fiscal year 1986: Final report.** Braslau, D.M.; Swigert, L.J.; Walsh, J.H. (B and M Technological Services, Inc., Cambridge, MA (USA)). Jul 1987. Contract AC02-85CH10248. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010813/JAW.

The Fiscal Year 1986 Weatherization Assistance Program was monitored in three midwestern States. Program monitoring is required by the Energy Conservation and Production Act (PL 94-384) and the regulations at 10 CFR 440 to ensure effective provision of weatherization assistance to low-income persons. The focus of the monitoring was on 23 subgrantees selected by CH/SLCP and distributed throughout the States of Ohio, Michigan, and Minnesota. Separate reports on the monitoring completed in each State were previously submitted to CH/SLCP. This Final Report presents an overview and summary of the work performed by B & M, including discussion of the findings of the monitoring team regarding the accomplishments and problem areas observed among the subgrantees visited. All areas revealed opportunities for improvement among the subgrantees with assistance from the various State Offices. Recommendations to improve subgrantee operations were presented in the reports prepared for CH/SLCP on the monitoring in respective States. Some additional recommendations are presented at the conclusion of this report.

36575 **(DOE/EI/20471—T2) Massachusetts Executive Office of Energy Resources. Final report. No. 2 home heating oil program 1987/88.** (Massachusetts Executive Office of Energy Resources, Boston (USA)). 1988. Contract FC01-87EI20471. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012125/JAW.

During the 1987/88 heating season, the Massachusetts Executive Office of Energy Resources (EOER) participated in the joint data collection program between State Energy Offices and the federal Department of Energy (DOE) Energy Information Administration (EIA). The purpose of the program was to collect and monitor retail and wholesale prices and inventories of No. 2 fuel oil during October through May. Collection of price and inventory data served several functions. The information collected through this program allowed the federal and state governments to respond to consumer, congressional and media inquiries regarding No. 2 fuel oil. The data also provided policy decision-makers with timely and accurate data necessary to determine the adequacy of state level in-

ventories and prices. In addition, the program assisted the states in the development of consistent data bases. A network for the states and the EIA to communicate the data was also established through the program. The final report summarizes the results from the price and inventory surveys conducted in Massachusetts over the 1987/88 heating season. Factors which influenced these results are also discussed.

36576 **(DOE/HWP—55) Technical and economic assessment for asbestos abatement within Facility 20470, Wright-Patterson Air Force Base, Ohio.** Gibson, S.M.; Ogle, R.B. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 167p. (ORNL/TM—10745). NTIS, PC A08;3. Order Number DE88007881/JAW.

This report presents the results of a technical and economic assessment of available alternatives for asbestos abatement within Facility 20470 at the Wright-Patterson Air Force Base in Dayton, Ohio. Each alternative was screened on the basis of technical feasibility, environmental impact, economics, and fulfillment of the IRP goals. Four alternatives for study are: establishing a special operations and maintenance program; enclosure; encapsulation with sealants; and removal, disposal, and replacement. Each of these alternatives was assessed for capability to control the release of asbestos fibers within Facility 20470. Alternatives 1 and 4 were determined to be acceptable, while Alternatives 2 and 3 were found to be unacceptable. 2 refs., 6 figs.

36577 **(DOE/ID/12584—18) Procedure manual for the estimation of average indoor radon-daughter concentrations using the filtered alpha-track method.** George, J.L. (UNC Geotech, Grand Junction, CO (USA)). Apr 1988. Contract AC07-86ID12584. 17p. (UNC/GJ—40(TMC)). NTIS, PC A03/MF A01;1; GPO Dep. Order Number TI88010380/JAW.

One of the measurement needs of US Department of Energy (DOE) remedial action programs is the estimation of the annual-average indoor radon-daughter concentration (RDC) in structures. The filtered alpha-track method, using a 1-year exposure period, can be used to accomplish RDC estimations for the DOE remedial action programs. This manual describes the procedure used to obtain filtered alpha-track measurements to derive average RDC estimates from the measurements. Appropriate quality-assurance and quality-control programs are also presented. The "prompt" alpha-track method of exposing monitors for 2 to 6 months during specific periods of the year is also briefly discussed in this manual. However, the prompt alpha-track method has been validated only for use in the Mesa County, Colorado, area. 3 refs., 3 figs.

36578 **(DOE/MI—0010-Vol.3) Instructor training manual: For use with energy conservation practices participant manual.** (Assignment Group, Rockville, MD (USA)). May 1988. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010726/JAW.

This manual is a tool for instruction to residential building tenants who are interested in enhancing energy conservation practices in their homes. (BCS)

36579 **(DOE/MI—0010-Vol.4) Conservation curriculum: Guide for public housing residents and renters.** (Assignment Group, Rockville, MD (USA)). May 1988. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010727/JAW.

This brief guide presents several examples of energy saving measures that can be used by public housing residents and renters. (BCS)

36580 **(DOE/NBM—8010176) Final report to the Champlain Valley Office of Economic Opportunity on Department of Energy energy-related business development grant: Final report.** (Memphremagog Group, Newport, VT (USA)). 23 Mar 1987. 86p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010176/JAW.

This study assessed the feasibility of developing an energy-related business to enhance the capabilities of Champlain Valley OEO's existing weatherization program. It was decided that, instead of one new business, two separate companies should be developed, a non-profit energy service company and a for-profit energy contracting company. Plans were developed for both companies.

36581 **(DOE/SF/11996—T1) [Laser diagnostics of gas discharge tubes]: Final technical report.** Stroke, H.H. (New York Univ., NY (USA)). 28 Mar 1988. Contract AC03-84SF11996. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008124/JAW.

The project was set up to develop the basic instrumentation and methods for optical diagnostics of plasmas. Specifically, the work was to permit the measurement of the radial distribution of atomic and ionic species in gas discharge tubes as exemplified by household fluorescent lamps. The aim is obviously to attempt to increase the efficiency by control of the discharge parameters. This report describes the system and results.

36582 **(DTH-LV-MEDD—185) Computer programmes for simulation of passive solar heating.** Christensen, J.E. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Oct 1987. 123p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752910/JAW.

In Denmark, several computer programs have been developed and used to simulate the energy consumption and the indoor climate in buildings. However, these programs are less suitable for investigation of passive solar systems since they can only provide analysis of a single room and cannot sufficiently consider the thermal effect of the heat-accumulating mass of the building. Therefore, the main purpose of this project has been to select suitable programs, and, if necessary, re-edit them specificly for passive solar energy simulations. The transfer of another American program, SERI-RES, into a PC-dode - the program SUNCODE - makes this program very interesting. That is the reason why it has been included in the last part of the project. However, the greatest importance to the project is related to the adaption and use of BLAST. A description is given of the BLAST-system, and the computer work carried out by the author with the system. This work has primarily consisted in the development of an independent program, JC-WRITER, which is able to read the output files from BLAST, adapt these data and print them in the formats wanted. BLAST and SUNCODE have been compared and validated using experimental results from a Canadian test cell, and from a Danish test house, one of the "Smakkebo" houses at Elsinore. In both cases there has been a good accordance between the measurements and the calculations of the energy consumptions. As for the temperatures, the agreement was relatively good for both cases. However, further investigations will be necessary as the temperature fluctuations in the Canadian test cell were to small, and as Smakkebo manifested some uncertain factors. Finally, a number of current projects in which the author has participated with BLAST calculations are briefly described. 65 refs. (SM).

36583 **(EMR—1987) R-2000 student design challenge, 1986-1987.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1987. 61p. (MICROLOG—88-01286). Ontario Ministry of Energy, Communications Services Group, 62 Wellesley St., West, Main Floor, Toronto, Ont., Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In order to promote design of energy efficient houses in Ontario, a yearly competition for architecture students has been initiated. Participants must design a detached house to R-2000 standards, and the designs submitted must be practical to build, marketable, and economical; the construction materials and techniqes have to ensure long term reliability and low maintenance cost, and the homes have to be affordable by an average-income family. This report presents the best designs submitted. Each house and its components are described, illustrated, and evaluated. HOTCAN computer calculations were used for modeling in many of the designs.

36584 **(EUR—10433-EN) Investigations of the performance of domestic central heating systems and of reductions in building fabric losses. Final report.** Rayment, R. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Building Research Establishment, Watford (UK)). 1986. 147p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

A description of the characteristics of a pair of houses in Oxfordshire (UK) and a set of 8 houses in Cambridgeshire (UK), specially instrumented, equipped with simulated occupancy and designed to provide an automatically operating test bed for accurately assessing energy conservation measures under realistic conditions, is presented. The description includes the constructional, thermal and air-infiltration properties together with the gas central heating systems and controls.

36585 **(EUR—10449-EN-Pt.1) Development of energy efficient electrical household appliances. Pt. 1. Refrigerators. Final report.** Guldbrandsen, T.; Heeboell, J.; Mehlsen, K.; Noergaard, J. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Danmarks Tekniske Hoejskole, Lyngby). 1986. 64p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

This final report is part one out of three parts describing a project on efficient household appliances. Earlier analyses indicated significant potentials for saving electricity used for refrigeration purposes. The work reported here was undertaken to verify those conservation potentials by designing and building low energy refrigerator prototypes. A 200 liter low energy refrigerator with no freezer compartment was designed. A few prototype cabinets were built with better insulation than usually. A compressor with improved performance was used in the refrigeration system installed in the cabinets. Furthermore, the evaporator and condensor were improved. The system is automatically defrosting. Electricity consumption for the low energy refrigerator was found to be 102 kWh/year under standard test conditions. This is about 20% of what a typical 1975-refrigerator of same size consumes, and 40% of what one of the best on the market consumes. Experimental tests indicated that the insulation standard was better than anticipated, while the refrigeration system was performing below the expected. Further reduction in electricity consumption is possible through a better adapted compressor, better control systems etc.

36586 **(EUR—10449-EN-Pt.2) Development of energy efficient electrical household appliances. Pt. 2. Cooking. Final report.** Holck, J.; Goldschmidt, L.B.; Heeboell, J.; Pedersen, N.H. (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation; Danmarks Tekniske Hoejskole, Lyngby). 1986. 78p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

The work has been focussed on the development of a small, highly insulated electric oven, low heat-capacity hot plates and an accurate electronic thermostat for electric hot plates. It has proved, that energy saving ovens can be built with good energy economy and at a reasonable price, so it has been estimated that there is a market for these ovens. Experiments with low heat-capacity hot plates made of aluminum have been carried out. Theoretical calculations have indicated possible energy savings around 20%, but the difficulties in producing such hot plates have proved to be considerable and requiring know-how and experience outside that of the laboratory. An experimental microprocessor based setup has been built for the investigation of different principles of control. Two principles have been examined: direct substitution in the model equations and prediction of the pan bottom temperature. The first principle has been tested experimentally, but the results have shown that the model, on which the control has been based, does not give an adequate description of the system. The second principle has appeared promising in computer simulations, but these results have not been verified experimentally.

36587 **(EUR—10449-EN-Pt.3) Development of energy efficient electrical household appliances. Pt. 3. Washing machines. Final report.** Heeboell, J.; Noergaard, J. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Danmarks Tekniske Hoejskole, Lyngby). 1986. 44p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

This third part of the final report is on washing machines. Earlier analyses indicated significant potentials for saving electricity in the process of washing clothes (5 and 6). Three major measures could be applied: 1) Reducing the amount of water, 2) reducing the temperature and 3) taking in hot water heated by other (and cheaper) energy sources than electricity. We have used most of our efforts on 1) but with some considerations given to 2). The project was intended to be carried out in cooperation with a manufacturer of washing machines, Voelund Husholdningsapparater A/S, but this factory closed down shortly after the project was started. During the period of the project, a new washing process and a prototype washing machine has been developed and tested. The basic change in this washing process is less use of water during the period with high temperatures. In a second stage the process was further improved into a resource efficient (RE-)process which uses less detergent and less water for rinsing in addition to the energy savings. Washing quality is found to be similar to that of average, 1982-washing machines. The annual electricity savings would be 140 kWh when compared to average 1982-machines. The necessary extra costs for a machine with this washing option would be paid back in saved electricity in 6.5 years, but including the detergent and water saved, the payback period is estimated to be less than 4 years. Since there is less mechanical action in this RE-process, it is likely that the wear of the clothing will be lower than usual.

36588 **(EUR—10552-EN) Natural ventilation in large and multicelled buildings: Theory, measurement and prediction. Final report (for the period: 1st October 1981 to 30th June 1984).** Perera, M.D.A.E.S.; Walker, R.R.; Hathaway, M.B.; Oglesby, O.D.; Warren, P.R. (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation; Building Research Establishment, Watford (UK)). 1986. 232p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Energy.

In this programme of work, methodologies for determining infiltration rates of large and complex buildings have been established. Solutions to this, hitherto, intractable problem have been obtained using a combination of theoretical and experimental studies. Theoretical considerations suggested that comprehensive information regarding interzonal air movements might be obtained from experimental techniques using multiple tracer gases. Field measurements to determine interzonal flows were carried out in office buildings using automated measurement systems developed for this purpose. It was recognized that, in most circumstances, simpler techniques, which would give less comprehensive but nevertheless useful information, were needed. Such a simplified technique has been developed. Theoretical and experimental work showed that, with this technique, it is probably sufficient to seed part of a complex building with a single tracer gas in order to measure the overall infiltration rate to a good approximation. Prediction models have also been used to determine the effectiveness of draughtstripping windows on the energy consumption of an office building. The predicted infiltration rates compared well with measured values. Energy calculations showed that, for this particular building, draughtstripping windows has reduced by 21% the seasonal gas consumption.

36589 **(KTM/E-D—84C) Efficient and the economical utilization of the electrical systems of buildings.** Elkala, E. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 72p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752819/JAW.

The objective of the third stage of the research project "the Energy economy of the buildings" is to create the instructions for

drawing up electrical plans with consideration of an economical and effecient utilization of electrical devices. Therefore the instructions include the planning and the documentation of the system significant from the point of view of the energy consumtion. With the choice of the right planning solutions the planner form the basis for an efficient and economical utilization of energy. The selection between alternatives requires consideration of not only the investment costs but also the costs of utilization and maintenance. The utilization costs can be effected by improving the quality of planning and developing professional skills. The planning must seek and develope new and more effecient solutions and draw attention to such control solutions which make possible the due utilization of electrical devices and equipments. The documents answering for the realization and serving the utilization and the maintenance, such as the final drawings, records of measuring and inspections, use specifications and maintenance instructions, convey to the organization responsible for the upkeeping the original idea for the utilization and the maintenance of the building. The documents also create premises for a systematical practice and the right maintenance habit.

36590 **(KTM/E-D—143) Test method for energy consumption with simulated occupancy.** Heinola, R.; Pukkila, I.; Pekkonen, J.; Lindqvist, P.; Schreck, T. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Aug 1987. 89p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752829/JAW.

The estimation of operating costs of a building and research for building materials and products call for comparable annual energy consumption data. Results given by conventional calculation methods are often unsatisfactory. Energy models of buildings can be derived from measurement data by solving parameters that characterize their their thermal properties. The data is produced during a few days' measurement period and analysed with linear regression analysis. The model described in this study has the following parameters: indoor/outdoor temperature difference, lagged temperature difference, room temperature variation, solar radiator, wind effect, and stack effect. These parameters and criteria for model reliability are solved from the data. The annual energy consumption of the building is calculated with these parameters and hourly weather data. A minimum value or variation is necessary for the outdoor conditions. Indoor/outdoor temperature difference must be at least 10-15 deg C. Diurnal variation of outdoor temperature must be at least 5-10 deg C. The measurement period should include at least one sunny day. There should be some variation of indoor temperature. The effective gap area, which represents the building envelope leaks, can be determined if wind velocity is 3 m/s or higher. The internal loads and occupant effects are simulated by heaters programmed to be on and off to produce a typical load profile. Seven single family houses and one apartment house were tested. In the apartment house, no simulation of internal loads and occupants was conducted as the house was occupied during the measurement period. There is some variation in the parameters of models from different periods. Nevertheless, the predict error of accepted 48 hour models is less than 5% for the measurement period.

36591 **(KTM/E-D—144) Facade as a solar collector in a forced air heated office building.** Laitinen, J.; Puumalainen, H. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Sep 1987. 57p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753326/JAW.

The object of this study was the new office building of Joensuu Electricity and Telephone Board, which was completed 1985. Forced air heating was selected as a heating system and there were located small electric radiators beneath the windows in rooms to make individual control possible in rooms and prevent possible cold draght from windows. There was utilized solar energy in building by using southern wall as a solar collector. This solar preheated outdoor air is introduced into the air conditioning system whenever space heating is needed in the building. The purpose of the measurements was to solve the operation of the operation of the air-conditioning and heating system in different circumstances and to find out how much energy was taken advantage by using this kind of facade. The total consumption of heating energy in the building during measurements of a year was 354.3 MWh/a = 39.1 MWh/m"3,a. 18.6% was obtained from the glass facade. Best period in heating season was end of spring, when air may warm up in collector from -20 deg C to +20 deg C. The consumption of heating electricity was 65.0 MWh/a = 7.2 kWh/m"3,a. The consumption of electricity not including heating electricity was 330.9 MWh/a = 36.6 kWh/m"3,a. The investment costs of forced air heating were in this building same class of magnitude as traditional heating and air-conditioning system would have cost. The costs of the glass facade were 118.000 mk = 204 mk/m"2. However, the glass facade didn't cause extra costs; another kind of facades could have been even more expensive. Preheating of supply air in space behind glass facade have proved to be profitable in this building. Because of the results got in this study, using of facade to preheat supply air would be a good alternative in small and middle-sized office buildings and for example in schools.

36592 **(LBL—23287-Rev.) Influence of glazing selection on commercial building energy performance in hot and humid climates.** Sullivan, R.; Arasteh, D.; Sweitzer, G.; Johnson, R.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 19p. (CONF-8709245—1-Rev.). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011962/JAW.

From ASHRAE conference on air conditioning in hot climates; Singapore, Malaysia (3 Sep 1987).

This paper presents a comparative study in which commercial building perimeter zone electric energy (cooling, lighting, fan) and peak electric demand are analyzed as a function of window glazing type, with a particular emphasis on the use of glazings with wavelength-selective solar-optical properties. The DOE-2 energy analysis simulation program was used to generate a data base of the electric energy requirements of a prototypical office building module located in Singapore. Algebraic expressions derived by multiple regression techniques permitted a direct comparison of those parameters that characterize window performance in hot and humid climates: orientation, size, and solar-optical properties. Also investigated were the effects of exterior and interior shading devices, as well as interior illuminance level, power density, and lighting controls to permit the use of daylighting. These regression equations were used to compare the energy implications of conventional window designs and newer designs in which the type of coating and substrate were varied. The analysis shows the potential for substantial savings through combined solar load control and lighting energy use reduction with daylighting.

36593 **(LBL—23501) Computer simulation of natural ventilation airflow.** Byrne, S.J.; Fleury, B. (Lawrence Berkeley Lab., CA (USA); Ecole Nationale des Travaux Publics de l'Etat, 69 - Vaulx en Velin (France). Lab. Sciences de l'Habitat). Sep 1987. Contract AC03-76SF00098. 11p. (CONF-8709268—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009843/JAW.

From ASHRAE Far East conference on air conditioning in hot climates; Singapore, Singapore (3 Sep 1987).

The current limitations, as well as recent improvements, in the capability of computer simulation programs to model natural ventilation airflow through buildings are described. The advantages and limitations of two techniques{emdash}the mass balance approach and the finite domain approach{emdash}are discussed. Results are shown from two sets of simulations, using typical building configurations, to illustrate the usefulness of each technique in predicting wind induced ventilation rate.

36594 **(LBL—24161) A large scanning radiometer for characterizing fenestration systems.** Papamichael, K.; Klems, J.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 11p. (CONF-8710322—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010354/JAW.

From Workshop on optical property measurement techniques; Ispra, Italy (27 Oct 1987).

A large scanning radiometer for measuring the bidirectional transmittance and reflectance of fenestration systems and components is described. Examples of measured data obtained for simple non-specular samples using the radiometer are presented. A method of obtaining the overall bidirectional properties of systems by calculation from scanning radiometer measurements of components is

suggested. Advantages and limitations of the method are discussed. The method appears promising.

36595 **(LBL—24704) A study of the interaction of NO_2 with carbon particles.** Gundel, L.A.; Guyot-Sionnest, N.S.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 21p. (CONF-871055—5; CONF-871055—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010778/JAW.

From 3. international conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (5 Oct 1987).

The interaction of NO_2 in air (0.5-35 ppM) with carbon particles led to three products: NO gas, and NO_2/sup {minus/} and NO_3/sup {minus/}, removed from the particles by water extraction. At 4 ppM or below, in dry or humid air, the product distribution, in relative molar amounts, was NO_3/sup {minus/} = $2NO_2$/sup {minus/} = 2NO. At 20 ppM and above, the relative amounts of products depended on the presence of water vapor: In dry air NO = $3NO_3$/sup {minus/} = $6NO_2$/sup {minus/}. In humid air NO = NO_3/sup {minus/} = $2NO_3$/sup {minus/}. For carbon slurries in water, [NO_3/sup {minus/}] = 6[NO_3/sup {minus/}] at an input concentration of NO_2 of 4 ppM. In comparison to carbon, alumina particles and glass beads removed NO_2 ineffectively. These results indicate that NO_2 oxidized the carbon particles while it was reduced to NO. NO_2 adsorbed at oxidized sites on the particles formed a surface species that was analyzed as nitrate. At high enough concentration of NO_2 (20 ppM and above), the interaction of NO and water vapor with the surface nitrate produced NO_2/sup {minus/}. In slurries NO, generated from interaction of NO_2 with carbon, reacted with surface nitrate or nitric acid in solution to form the relatively large quantities of nitrite. This work suggests that NO/sub x/ reactions with carbon in droplets or on wet surfaces could be important sources for the production of nitrous acid in the environment. 19 refs., 7 figs., 1 tab.

36596 **(LBL—25124) Determination and application of bidirectional solar-optical properties of fenestration systems.** Papamichael, K.; Klems, J.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. 9p. (CONF-880615—3; CONF-880615—). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010364/JAW.

From Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference; Cambridge, MA, USA (18 Jun 1988).

Accurate determination of the luminous and thermal performance of fenestration systems that incorporate optically complex components requires detailed knowledge of their radiant behavior. We describe a large scanning radiometer used to measure the bidirectional transmittance and reflectance of fenestration systems and components. We present examples of measured data obtained for simple non-specular samples. We describe a method of obtaining the overall properties of fenestration systems by calculation from scanning radiometer measurements of fenestration components. Finally, we describe the application of bidirectional solar-optical properties of fenestration systems to determine their luminous and thermal performance with respect to building energy consumption and occupants' comfort. We also discuss the advantages and limitations of the method, which appears to be promising.

36597 **(LBL—25127) Evaluation of radon reduction techniques in fourteen basement houses: Preliminary results.** Turk, B.H.; Harrison, J.; Sextro, R.G.; Hubbard, L.M.; Gadsby, K.J.; Matthews, T.G.; Dudney, C.S.; Sanchez, D.C. (Lawrence Berkeley Lab., CA (USA); Princeton Univ., NJ (USA). Center for Energy and Environmental Studies; Oak Ridge National Lab., TN (USA); Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). May 1988. Contract AC03-76SF00098. 24p. (CONF-880679—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010773/JAW.

From 81. annual meeting of Air Pollution Control Association; Dallas, TX, USA (1 Jun 1988).

This paper reports the preliminary results of a study of radon control techniques in 14 homes in New Jersey. The study was initiated to investigate the fundamentals of soil gas flow and radon entry into buildings and the factors that influence the entry rate, develop a diagnostic procedure for specifying appropriate and effective remedial measures, and better understand the operation of certain mitigation techniques and the parameters that affect them. Reported here is a description of the radon control work that was conducted in the houses and a summary of the results of that work. At this time, a detailed analysis of the relationship between the parameters affecting system performance has not been conducted. 9 refs., 10 figs., 6 tabs.

36598 **(LIU-TEK-LIC—1986-31) Optimal energy retrofits on existing multifamily buildings.** Gustafsson, S.I. (Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering). Nov 1986. 155p. Linkoeping Univ. Library, S-581 83 Linkoeping, Sweden.

Linkoeping studies in science and technology.; (No. 91).

It is important to consider the building as an energy system when determining the retrofits done to the house. In Sweden today it is common to make both an extensive envelope retrofit and change the existing heating system to district heating. This is absolutely wrong, at least if the district heating company is using the short range marginal cost pricing system. Today it is also common to implement the retrofits due to its profitability. This is in most cases wrong. Starting e g with caulking and some insulation retrofits makes the building consume less energy, but this also means that it is impossible to install a heat pump with any profitability. The right strategy perhaps should have been to install the heat pump and skip all of the envelope retrofits. It is shown that much more insulation shall be placed on the climate shield than is common today. It is important that the insulation measures are implemented at the same time that other things are done e g the wall. Most insulation retrofits are only profitable if that is the case. Complicated window constructions will almost never be profitable as an optimal strategy unless the windows have to be changed for other reasons. The same can be said about the exhaust air heat pump retrofit. The cheapest retrofit, the caulking of windows and doors, is almost always profitable.

36599 **(LUTKDH/TKKA—7003-1-83(1986)) Calculation methods for sorption heat pumps using enthalpy-concentration charts.** Eriksson, K.; Jernqvist, Aa. (Lund Inst. of Tech. (Sweden). Dept. of Chemical Engineering). Jun 1986. 103p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752913/JAW.

Calculation methods for absorption heat pumps and heat transformers are described and graphically demonstrated in enthalpy-concentration charts. Special attention is payed to the estimation of pressures, temperatures, heat factor and circulation ratio. Every unit involved - generator/rectifier, absorber, condenser, heat exchangers, pumps and expansion valves - described in detail. Mass- and energy flows are graphically calculated. Efficiencies, especially for absorber and generator, are based only on temperatures. These efficiencies take into consideration the varying absorber and generator temperatures which should be exploited. Approximate values of temperature differences, circulation ratio, heat factor and efficiencies for different running conditions are given. Calculation examples for the absorption heat pump as well as the heat transformer illustrate the graphical method, which is especially suitable for preliminary calculations such as for instance pre-projecting. (authors).

36600 **(NEI-DK—62) Achieving substantially reduced energy consumption in European type refrigerator.** Guldbrandsen, T.; Norgard, J.S. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). May 1986. 13p. (CONF-8605334—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752835/JAW.

From 37. annual international appliance technical conference; Lafayette, IN, USA (6 May 1986).

For several years the Energy Group at Physica Laboratory III has been working on improving energy efficiency of household appliances. Part of the work is analytical, but in recent years also experimental work has been carried out, especially on refrigerators. In Europe it is common to have refrigerators with + 5 deg. C and freezers with -18 deg. C as two separate units. This is appropriate from an energy conservation point of view, and we have therefore investigated a typically sized 200 litres refrigerator with automatic defrosting but no freezer compartment. At present one such proto-

type at our laboratory shows an electricity consumption of 82 kWh/year, according to European standard test procedures. This is around 45% of the consumption for the best model on todays Danish market with the same features (or 16% of what was typical in 1973). The costeffectiveness of our improvements seems good. The paper describes how our prototype is designed to achieve the savings by 1) lowering transmission loss by moderately increasing insulation thickness and 2) increasing COP by reducing temperature differences between heat exchangers and the surrounding air. The reduced temperature differences are in turn obtained by redesigning the heat exchangers for larger sizes and larger heat capacities. Although a COP value of 2.3 is attained there is still room for improvements towards the value of 14 for a thermodynamically ideal system.

36601 **(NEI-FI—35) Checking and the testing of refrigerating systems.** Kaappola, E. (Insinoeoeritoimisto Air-Ix Oy, Tampere (Finland)). May 1987. 53p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752838/JAW.

This work deals with the cheking and the testing of refrigerating systems in practice. This is aimed as a quidebook for persons working in the field. However the tests should be made only by the persons who have the necessary technical knowledge and experience. The checking of refrigerating system is described step by step. Information for important points is described in such way that also beginners can use it. The testing of refrigerating systems is described in general. That part includes information for organization of tests, measurement of refrigerating capacity, measurement of energy consumption, measuring instruments, tolorances and statement of result.

36602 **(NRC/BR—117) Net annual heat loss factor method for estimating heat requirements of buildings.** Mitalas, G.P. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). Nov 1976. 13p. (CE—01487). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The development of energy budget standards for buildings makes it necessary for designers to produce accurate estimates of the amount of energy required to heat a building. The most widely used method of calculating annual heating requirement is the ASHRAE degree-day procedure. This paper presents a modification of the degree-day method to allow designers to take more accurate account of: solar radiation incident on a building surface, variation of solar energy gained through windows, variation of air infiltration rate, and the heat generated by inside activity and its effect on building energy needs. This modified degree-day method is called the Net Annual Heat Loss Factor (NAHLF) method of estimating heat requirements of buildings. It is based on the fact that the total annual building heat loss can be separated into the following four components: window heat loss, opaque wall and ceiling heat loss, air infiltration-ventilation heat loss, and basement (below ground) heat loss. Each of these heat loss components can be calculated separately using NAHLF. This paper describes how these factors have been evaluated and how they can be used to estimate net annual heating requirements for simple buildings. Total house heat loss (except for basement below grade) calculated by the ASHRAE method compares well with the total heat loss componets calculated by the two methods, however is not as good as the comparison of the total losses where the highest difference is in window and infiltration components. 7 refs., 8 figs., 4 tabs.

36603 **(NRC/BR—NRC105) Determining the optimum thermal resistance for walls and roofs.** Stephenson, D.G. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). Jan 1976. 13p. (CE—01485). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper provides information about deciding how much insulation should be used for residential walls and roofs. The approach suggested takes account of inflation and the expected increase in the cost of fuel during the lifetime of a building. The economic analysis used for this study is straight forward: the annual heat loss through unit area of a wall or roof is expressed as a function of the thermal resistance, and the cost of providing this amount of heat for the lifetime of a building is taken as the discounted present worth of the series of annual payments that would be required to purchase this heat. The cost of constructing walls and roofs with different resistance values is estimated and the optimum resistance is taken as the one that has a minimum total cost, i.e., the lowest sum of first cost plus the present worth of the heat that would pass through a wall or roof. It is concluded that there are two key prices of data that have to be established before the optimum heat resistance can be determined: the incremental cost of constructing walls or roofs with various values of R in excess of 12.5, and the value of the present worth factor that should be used for converting future fuel savings into a current lump-sum value. On the basis of the data assumed in this study it appears that an R=20 wall would be appropriate for most parts of Canada. 1 ref., 3 figs., 1 tab.

36604 **(NYSERDA—87-31) Low-cost conservation measures delivery service: A systematic approach for providing weatherization services: Final report.** (New York City Dept. of Housing Preservation and Development (USA)). Oct 1987. 72p. New York State Energy Research and Development Authority, Two Rockfeller Plaza, Albany, New York 12223;3. Order Number TI88010323/JAW.

This report gives an account of the Conservation Delivery Service Multi Family Buildings project and its activities by topic. Where applicable, there is an evaluation and recommendations section which contains the HPD Energy Conservation Unit (ECU) appraisal of the activity and how it might be conducted in future projects. While this report has primary relevance to New York City (NYC) conditions, it should prove useful to planners and managers in other cities with aging multi family housing stock. A comparison report deals with the Conservation Measures Delivery Service program as it treated 1-4 dwelling unit buildings during the same period as the multi family program was operating.

36605 **(ORNL/M—530) Building Thermal Envelope Systems and Materials (BTESM) and research utilization/technology transfer: Monthly progress report, March 1988.** Samples, S.D.; Coleman, G.L. (comps.). (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010735/JAW.

The Monthly Report of the Building Thermal Envelope Systems and Materials (BTESM) Program is a monthly update of both in-house ORNL projects and subcontract activities in the research areas of building materials, wall systems, foundations, roofs, building diagnostics, and research utilization and technology transfer.

36606 **(PB—88-183025/XAB) Advanced energy system program. Annual report, June 1986-February 1987.** Trester, K. (Allied-Signal Aerospace Co., Torrance, CA (USA). AiResearch Los Angeles Div.). Jun 1987. 119p. (DOC—87-60676). NTIS, PC A06/MF A01.

The objectives of the program are to design, develop, and demonstrate a natural-gas-fueled, highly recuperated, 50-kW Brayton-cycle cogeneration system for commercial, institutional, and multifamily residential applications. Recent marketing studies have shown that the Advanced Energy System (AES), with its many unique and cost-effective features, has the potential to offer significant reductions in annual electrical and thermal energy costs to the consumer. Specific advantages of the system that result in low cost of ownership are high electrical efficiency (34%, LHV), low maintenance, high reliability, and long life (20 years). Significant technical features include: (1) an integral turbogenerator with shaft-speed permanent magnet generator; (2) a rotating assembly supported by compliant foil air bearings; (3) a formed- tubesheet plate/fin recuperator with 91% effectiveness; and (4) a bi-directional power conditioner to utilize the generator for system startup. The planned introduction of catalytic combustion will further enhance the economic and ecological attractiveness.

36607 (PB—88-191796/XAB) Guidelines for factory-building design. Part 4. Air quality. Part 5. Fire protection. Senior, J. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Building Research Inst.). 1985. 80p. NTIS, PC E06/MF E06.

Summary in Afrikaans. See also PB—83-245514; North American Continent sales only.

Contents include: Part 4: air quality (historical background, legislation, composition of the factory air: oxygen/carbon dioxide, odors, air contaminants and their industrial sources, air contaminants and respiratory diseases, monitoring air quality in factories, explosion hazards, control of airborne contaminants, external pollution, personal respiratory protection); Part 5: fire protection (nature of the fire hazard, causes and effects, the control of fire, building design, escape, precautionary measures, protection against fire).

36608 (PB—88-192463/XAB) Flame roll-out study for gas-fired water heaters. Kao, J.Y.; Ward, D.B.; Kelly, G.E. (National Bureau of Standards, Washington, DC (USA). Building Environment Div.). Mar 1988. 159p. (NBSIR—88/3724). NTIS, PC A08/MF A01.

Five gas-fired water heaters were tested in laboratory with simulated home conditions to evaluate their flame roll-out characteristics. Simulated variables were flue blockage, space pressure depression, access-door status and other related factors. Test results were compared with those based on the proposed American National Standards Institute (ANSI) test method. The testing concludes that, in addition to flue blockage, pressure depression and door status are major factors in inducing heater flame roll-out; that poor draft-hood performance contributes to the likelihood of flame roll-out; that the proposed ANSI test method should add a temperature criterion for determining flame roll-out; that the proposed ANSI blocked-flue test appears to be adequate for units equipped with thermal-spill switches located at their access-doors area. Recommendations are made that the Consumer Product Safety Commission (CPSC) and the ANSI subcommittee on water heaters consider also requiring the interlocking of access doors with water-heater operation, the use of temperature sensing as a means of detecting flame roll-out, and the use of improved draft-hood designs and draft-hood performance testing to reduce the chances of flame roll-out.

36609 (PB—88-195268/XAB) Residential construction code impacts on radon. Galbraith, S.; Brennan, T.; Osborne, M.C. (Camroden Associates, Rome, NY (USA)). Apr 1988. 12p. NTIS, PC A03/MF A01.

The paper discusses residential construction-code impacts on radon. It references existing residential construction codes that pertain to the elements of construction that impact either the ability to seal radon out of houses or the ability to achieve good soil ventilation for radon control. Several inconsistencies in the codes that will impact radon resistant construction are identified. Resolution of these resulting radon issues is necessary before specification-style building codes can be developed to achieve radon-resistant construction.

36610 (PNL—6525) An annotated bibliography of completed and in-progress behavioral research for the Office of Buildings and Community Systems. Weijo, R.O.; Roberson, B.F.; Eckert, R.; Anderson, M.R. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 119p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88011360/JAW.

This report provides an annotated bibliography of completed and in-progress consumer decision research useful for technology transfer and commercialization planning by the US Department of Energy's (DOE) Office of Buildings and Community Systems (OBCS). This report attempts to integrate the consumer research studies conducted across several public and private organizations over the last four to five years. Some of the sources of studies included in this annotated bibliography are DOE National Laboratories, public and private utilities, trade associations, states, and nonprofit organizations. This study divides the articles identified in this annotated bibliography into sections that are consistent with or similar to the system of organization used by OBCS.

36611 (SNV—3104) Outdoor noise from heat pumps in houses. Bodlund, K. (National Swedish Environmental Protection Board, Solna). 1986. 64p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752941/JAW.

Noise levels were measured outdoors at 12 heat pump installations in one-family houses at the site, and on neighbour's plots. Involved persons were interviewed in order to find out if and how the noise levels were disturbing. The disturbances have been related to the frequency spectrum of the noise and it was found that noise levels expressed in dBA agree well with the subjective experiences. A suggestion is finally given for classifying the heat pump noise and giving relevant installation recommendations for each class. With 25 refs.

36612 (STU—83-3876) Heating system for small houses. Fehrm, M. (Swedish National Board for Technical Development, Stockholm). 15 Aug 1986. 7p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752976/JAW.

Modern swedish houses with good insulation have so small heat requirements that air heating systems may be used. In this project the use of plastic pipes with 50mm diameter for heat distribution has been studied. It was found that such piping has capacity enough for the heat distribution, but that other considerations give unfavourable results for this system, i.e. certain components are relatively expensive (joints, bends, silencers, distribution boxes), the flexibility is low, and, the system produces noise due to the high air velocities. (L.E.).

36613 (TKK-KO/LVI—B14) Model test of air-exchange efficiency. Krzysztof, K. (Helsinki Univ. of Technology, Otaniemi (Finland)). Apr 1987. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752862/JAW.

The report provides a summary of the laboratory tests. The mixing air flow patter was studied. Three air flows were tested in a laboratory test room. The tracer gas technique and decay method were used. The indices of air exchange efficiency were calculated, namely: overall air exchange efficiency and room air mean age for the whole room; local ventilation indices and local mean ages of air at 10 points distributed throughout the room. Experiments were carried out in both isothermal and nonisothermal conditions. Based on the theory of similarity requirements a reduced-scale model, geomettrically similar to the laboratory test room, was built. Air flows and temperature differences were calculated for the model tests in order to make them comparable with the full scale and the tests were repeated. Air served in the model test as a working fluid (Pr=const.) and regrigerant 12 was used as the tracer gas both in the full scale and model tests. The ojective of the study was to determine the relation between the air exchange efficiency indices obtained in the model and on the full scale. The overall air exchange efficiencies and local ventilation indices were equal in the model and full scale when there was no short-circuiting. A new formula for calculating local mean ages on a full scale, based on a reduced scale model experiment, was developed.

36614 (TKK-KO/LVI—B16) Performance of ventilation in residential buildings. Ruotsalainen, R.; Majanen, A. (Helsinki Univ. of Technology, Otaniemi (Finland)). 1987. 153p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752864/JAW.

The aim of this study was to survey the performance of ventilation in residential buildings. Particularly the effect of various ventilation systems on air-exchange rate in rooms, indoor air climate, satisfaction and health was studied. The research was carried out with field measurements and a questionnaire to inhabitants. Seven apartments in small houses and six apartments in block of flats were selected into the research. There were different kinds of ventilation systems in the apartments. The air-exchange rates in the dwellings varied a lot; the ventilation rates were from 0.1 to 0.7 1/h. Only in three dwellings the official minimum ventilation rate 0.5 1/h was achieved. The lowest air-exchange rates were measured in the dwellings where the mechanical ventilation system was usually not in operation. The ventilation rates were then only about 0.1 1/h. The ventilation rates were about 0.4-0.5 1/h in the dwellings with

natural ventilation. Closed bedroom doors reduced the air-exchange rate in the room, except in the dwellings with mechanical air supply into each room. A quiding correlation was found between the air-exchange rates of the dwellings and the satisfaction and health of the inhabitants. When the ventilation rate was low i.e. under 0.3 l/h, the inhabitants were usually not satisfied with the performance of the ventilation system. Similarly the symptoms of tiredness and the symptons from respiratory organs were more common, when the ventilation rate was low.

36615 (TKK-KO/LVI—B17) Survey about air velocities, fluctuation frequencies and turbulence intensities in dwelling and offices. Kovanen, K.; Majanen, A.; Siren, K. (Helsinki Univ. of Technology, Otaniemi (Finland)). 1987. 94p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752865/JAW.

The purpose of the present study was to survey air velocities, fluctuation frequencies and turbulence intensities in dwellings and offices and discuss the influence of air distribution systems on the measured factors. The study was accomplished by making field measurements in 23 spaces with most typical ventilation and air distribution systems. The instrumentation was designed and built in the laboratory of Heating, Ventilating and Air Conditioning of Helsinki University of Technology. In order to analyse fluctuation frequencies a computer program, that uses Fast Fourier transform method, was developed. Generally the mean velocity and the turbulence intensity were in no obvious connection with the air distribution system. As an exception one can state the system with mechanical exhaust with supply to hall, where the mean velocities and the turbulence intensities were obviously lower than in other systems. In most spaces the mean velocities near the floor level were highest and correspondingly the turbulence intensities were lowest. In the dwellings the mean velocities were obviously lower than in the offices. The turbulence intensity varied remarkable. About 90% of the accepted values varied: from 25 to 50% at head level, from 20 to 45% at 15 cm above the floor level and from 15 to 40% at 5 cm above the floor level. The turbulence intensities were found to be higher in the winter conditions than in the summer conditions. The mean velocity and the standard deviation had no generally accepted relationship. Neither the spectra investigated had any predominant frequency in the range of 0.1-1.0 Hz.

36616 (TKK-KO/LVI—C31) Method for ventilation measurements. Saeteri, J.; Majanen, A. (Helsinki Univ. of Technology, Otaniemi (Finland)). 1987. 47p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752866/JAW.

The aim of this study was to develope cheap and simple method for ventilation measurements in dwellings. The study is based on a previous report of field measurement equipment for ventilation effiency and air exchange rate (Aalto, Niemela, Toppila, Toosavainen: Ilmanvaihdon tehokkuuden ja ilmanvaihtuvuuden kenttamittauslaitteisto.1984. Indoor Climate Project, Institute of Occupational Health, Helsinki University of Technology, HVAC-laboratory, Report C:11. Here has been concentrated on the use of carbon dioxide as tracer gas and indicator tubes for the measurement of air exchange rate. Laboratory experiments in a test chamber has been made to test the applicability of carbon dioxide indicator tubes in ideal conditions and to compare results with the air exchange rate measured by multipoint measurement equipment using Freon-12 as tracer gas. Field measurements in three typical dwellings has been made to estimate the usability of the indicator tube method for measurements in situ. The method presented here is applicable for measuring air exchange rate in dwellings with natural or exhaust ventilation system. With his method 20% measurement inaccuracy is gained, measurement time varying from 2 to 3.5 hours dependent on the air exchange rate. To achieve the mentioned inaccuracy there must not be any other sources of CO_2 except the measurer in the room during the decay time. This measurement method is very suitable for de termining the ventilation rate in a single room. In the end of the report there is a detailed measurement instruction and a measurement record, with which the air exchange rate can be determined grafically.

36617 (TKK-KO/LVI—C38) Indoor air components and health. Part 2. Sammaljaervi, E. (Helsinki Univ. of Technology, Otaniemi (Finland)). 1987. 64p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752867/JAW.

This litterature review is a second one made during the Project "Indoor Air Quality and Ventilation Requirements". The review is based on the newer and older research material being gathered by the author within the last few years. First are presented most of the primary and well-defined indoor air pollutants with known health hazards. Second, the most important dynamic features of indoor spaces and their health effects are evaluated. The dynamic features are: tightness, air exchange, temperature, humidity, electro-magnetic fields and ions. Ambient air pollutants and weather changes are related to changes in the health qualities of indoor spaces. At last, a current state of Finnish indoor air research activities is presented. The most important health and comfort features of buildings are supposed to be: dusts in the indoor air, on the indoor surfaces, in and from the textiles, tightness of the space and to this related inadequate air exchange, smelling (organic) gaseous pollutants from building or surface materials and from furniture, unphysiological temperature and humidity relations especially druing the cold season, and smells, dusts and noise from outside. Older buildings may be flimsy, chilly and draughty. The direct electrical heating (with wall panels) is clearly a health hazard in reference to customary water base central heating. There exist no comprehensive surveys of the mold problems in Finnish dwellings. Dusts and irritant chemicals in working environment and the ones, often in much lower concentrations, in homes produce very similar symptoms and diseases. The negative physical features, even in very low power, in dwellings constitute a background nouse which makes people now more vulnerable for diseases and bad working capasity. The research of the physical indoor environmen and its impact on health is in primary stage. Today's research results are no transferable to different climatic zones.

36618 (VTT-TIED—752) Cold worked reinforcing bars in tensile test under high loading rate and low temperatures. Hyvoenen, T. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Sep 1987. 61p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752993/JAW.

The behaviour of reinforcing steels in rapid loadings, e.g. in piling, explosions, crashings, must be known for designing. There does not exist studied of such properties of reinforcing steels used in Finland. This report presents the behaviour of reinforcing steels in rapid tensile tests carried out at temperatures +20 deg C, -20 deg C and -60 deg C. The steels are tested with a pendulum which swings around a bearing on the one end, fixed on the roof and the other end catches the test bar and draws it broken. The tensile-time curve is recorded electrically and elongation is measured from works. The results show that strength values are about 1.5 x values in ordinary tensile tests at room temperature. Strengths increase a little with decreasing test temperature. Thus the elongation values are higher at temperatures +20 deg C and at -20 deg C, at -60 deg C temperature elongation decreases under the reference value by ordinary test.

36619 (VTT-TIED—789) Optimization method for managing a renovation project. Aikkila, A.; Hekkanen, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Nov 1987. 187p. (In Finnish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88752999/JAW.

The aim of the study was to create a systematics for mastering the components which improve the value of a building in a renovation project. The purpose was to create a controlling method to optimize the gain as efficiently as possible. The study was limited to the preliminary design phase of a renovation project. An evaluation method to measure the changing value of a building was developed using a prametrization of the features of a building. The parameters were given numerical values to describe the relative importance of each feature. An optimization was done between the various alternatives in renovating by comparing the results of the parametrization to the total renovation costs. An operational model for managing the most advantageous alternative in renovating was presented

for the preliminary design phase of a project. The model was exemplified by two case studies. They showed that the method is rather sensitive to the variations in appraising the value of a building. The study resulted in a controlling method which optimizes the change of the value of a building against the total renovation costs. This method should be further developed to take into account also the changes in the maintenance costs of the building caused by the renovation project.

36620 **(VTT-TUTK—484) Computerization of building standards.** Kaehkoenen, K.; Bjoerk, B-C. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1987. 111p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752872/JAW.

The number, scope and degree of detail of building regulations and standards has increased greatly over the last 20 years. Thus, designers today encounter difficulties in coping with this mass of information and its frequent updates. The authorities enforcing building regulations are also facing difficulties, due to the problems in checking designs created with the aid of a diverse selection of software. It seems that information technology may provide useful tools towards solving these problems. For example, special software tools can be used for writing regulations and standards which contain less contradictions and which are easier to understand and implement. Furthermore, software can be developed to help designers check that the designs they have created either manually or using CAD-systems are in accordance with the regulations. The publication is concerned with both the theoretical foundations and the software tools for computerizing building regulations. Previous research, especially from the United States Australia and the United Kingdom, is also briefly reviewed. The second part of the presentation describes a number of prototype systems developed at the Technical Research Centre of Finland. These include an expert system for fire regulations running in a question and answer mode and an augmented expert system which contains descriptive pictures illustrating the implementation of regulations. Next an example of integration of an energy calculation program with a CAD-system is described. Finally, current work related to the use of optical video discs as storage and presentation media for computer-controlled regulations data is briefly presented. As a conclusion, some propositions are given concerning research and development work in the computer aided creation and use of building standards.

36621 **Triple effect absorption chiller utilizing two refrigeration circuits.** De Vault, R.C. (to Dept. of Energy, Washington, DC). US Patent 4,732,008. 22 Mar 1988. Filed date 24 Nov 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A heat absorption method for an absorption chiller is described comprising: (a) providing a first absorption system circuit for operation within a first temperature range; (b) providing a second absorption system circuit for operation within a second temperature range which has a lower maximum temperature than the first temperature range; (c) heat exchanging refrigerant and absorber solution from the first circuit condenser and absorber with absorption solution from the generator of the second circuit; and (d) the evaporator of the first circuit and the evaporator of the second circuit both being disposed in thermal communication with an external heat load to withdraw heat from the heat load.

36622 **Saving electricity in commercial buildings with adjustable speed drives.** Eto, J.H.; De Almeida, A. (Lawrence Berkeley Lab., Berkeley, CA (US)). pp 91-95 of Industrial and commercial power systems technical conference (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870509—).

From IEEE/IAS industrial and commercial power systems conference; Nashville, TN, USA (4 May 1987).

This paper describes fan and chiller energy savings achievable in commercial buildings with adjustable-speed drives. The savings are estimated with the aid of parametric simulations from a sophisticated, hourly building energy simulation model. Two prototypes - a single-zone, retail store, and a multi-zone, medium office building - are simulated for five U.S. locations. The model incorporates part-load performance curves for both inlet vane and adjustable-speed drive controls for fans and centrifugal chillers. The results identify economic conditions that justify the added expense of adjustable-speed drives.

36623 **Development requirements for advanced industrial heat pumps.** Chappell, R.N.; Priebe, S.J. (U.S. Dept. of Energy, Idaho Operations Office, Idaho Falls, ID (US)). pp 2049-2055 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC07-76ID01570.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879440.

State-of-the-art industrial heat pumps have the potential to offer significant energy savings in industrial processes, if they are appropriately integrated into the process energy network. Advanced heat pumps have the potential to offer even greater energy savings in many processes. The most important development requirements for advanced heat pumps are greater temperature lift and shorter payback times, which can be accomplished through a combination of improved performance and lower capital cost. To determine the characteristics needed for improved performance, a heat pump must be viewed not in isolation, but in terms of the total process. This requires a knowledge of both the energy flow through the process, and the nature of the appropriate process streams.

36624 **Evaluation of power control methods for free-piston Stirling engine driven heat pumps.** Griffin, F.P.; Domingo, N.; Chen, F.C. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 1875-1879 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC05-84OR21400.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879412.

Aside from the problems of starting, a free-piston Stirling engine (FPSE) driven heat pump will tend either to stall or to overstroke if the FPSE power output is not controlled or matched to the compressor power requirement. Ambient temperature variations can create large changes in the power required to compress the refrigerant. An analysis was performed to investigate power control options for FPSE heat pumps. Six different FPSE power control methods were analyzed to determine their effect on the thermal performance of a heat pump system. The six control options are: 1) a displacer gas spring average volume control, 2) a displacer gas spring damping valve control, 3) a displacer alternator control, 4) an engine average pressure control, 5) an engine compression space average volume control, and 6) a compressor clearance volume control. Predicted engine efficiencies were best for control operations 4 and 6, and worst for options 2 and 3. The heat pump heating and cooling capacities were most nearly optimum for option 3, and worst for option 4.

36625 **Assessment of radioisotope heaters for remote terrestrial applications.** Uherka, K.L. (Argonne National Lab., Argonne, IL (US)). pp 1617-1622 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879341.

This paper examines the feasibility of using radioisotope by-products for special heating applications at remote sites in Alaska and other cold regions. The investigation included assessment of candidate radioisotope materials for heater applications, identification of the most promising cold-region applications, evaluation of key technical issues and implementation constraints, and development of conceptual heater designs for candidate applications. Strontium-90 (Sr-90) was selected as the most viable fuel for radioisotopic heaters used in terrestrial applications. Opportunities for the application of radioisotropic heaters were determined through site visits to representative Alaskan installations. Candidate heater appli-

cations included water storage tanks, sludge digesters, sewage lagoons, water piping systems, well-head pumping stations, emergency shelters, and fuel storage tank deicers. Radioisotopic heaters for freeze-up protection of water storage tanks and for enhancement of biological waste treatment processes at remote sites were selected as the most promising applications.

36626 **Indoor air quality control techniques. Radon, formaldehyde, combustion products.** Fisk, W.J.; Spencer, R.K.; Grimsrud, D.T.; Offermann, F.J. Park Ridge, NJ; Noyes Publications (1987). 245p. Noyes Publications, Mill Road at Grand Ave., Park Ridge, NJ 07656.

This book reviews and evaluates existing indoor air quality control techniques. The indoor air pollutants of most concern are radon, formaldehyde, and certain combustion products-nitrogen dioxide, carbon monoxide, carbon dioxide, and various respirable particles. Many techniques exist to control the concentration of these pollutants and other indoor pollutants that are only now being recognized as significant. The purpose of the book is to provide a current review and evaluation of these control techniques.

36627 **Photometric measurements in atria using the luminance mapper.** Balcomb, J.D.; Weaver, N. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO (US)). pp 182-187 of Proceedings of the 12th passive solar conference. Andrejko, D.A.; Hayes, J. Boulder, CO; American Solar Energy Society (1987). (CONF-870711—).

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

Preliminary data are presented based on measurements using the luminance mapper in an atrium in Denver, Colorado. This photometric instrument is a digital video scanning system that records luminance values from the image plane of a fish-eye lens. Analysis of these data reveals that the predominant source of illumination on the atrium floor is from the diffuse sky; however, 20.3% is from non-glazed enclosing surfaces, clearly indicating that interreflections make an important contribution. Consistency of the data suggests that some improvements in experimental technique are desired; however, the value of the luminance mapper as a photometric tool is clearly demonstrated.

36628 **Recent improvements and sensitivity of the VISION glazing system thermal analysis program.** Sullivan, H.F.; Wright, J.L. (Advanced Glazing System Lab., Dept. of Mechanical Engineering, Univ. of Waterloo, Waterloo, Ontario (CA)). pp 145-149 of Proceedings of the 12th passive solar conference. Andrejko, D.A.; Hayes, J. Boulder, CO; American Solar Energy Society (1987). (CONF-870711—).

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

VISION is a computer program that was designed to perform a two band (solar and thermal) one dimensional analysis of a wide variety of glazing systems. Specifically, it is capable of calculating U-values and shading coefficients for ASHRAE winter and summer design conditions plus user specified design conditions. An hour-by-hour energy analysis is optional. Recent modifications to VISION are described. These modifications include a revised method for calculating U-value and shading coefficient, user specified design conditions, graphic output and an input library for optical properties of various glazings. Simulation results detail the sensitivity of glazing system U-value with respect to variations in imposed environmental conditions. Environmental conditions examined include temperature level, indoor/outdoor temperature difference, solar radiation intensity and fraction cloud cover.

3202 Transportation

REFER ALSO TO CITATION(S) 35607, 36152, 36703, 37287

36629 **(AD-A—190262/6/XAB) Hot in-place recycling of asphalt pavements. Master's thesis.** Dowdy, M.L. (Texas A and M Univ., College Station (USA)). 4 Aug 1987. 110p. NTIS, PC A06/MF A01.

The purpose of this report is to identify factors to consider in selecting a hot in-place recycling project for asphalt pavements. This report discusses the different types of recycling processes and several selected hot in-place recycling processes that are becoming so popular today. The types of asphalt pavement distress and their causes are discussed to provide a working knowledge of possible applications for this process. Discussions on project selection, design, and construction considerations will also provide an awareness of considerations relative to this type of asphalt-pavement rehabilitation. An understanding of these topics will be helpful when selecting hot in-place recycling. The information that this report is based upon was obtained from various sources. A literature search included technical reports, periodicals, and advertisements. Personal contact was made in the form of interviews with a number of representatives in the industry and on site inspection of Cutler Repaving, Inc. and Remixer Contracting Co., Inc. operations.

36630 **(CONF-880139—4) An efficient computational tool for ramjet combustor research.** Vanka, S.P.; Krazinski, J.L.; Nejad, A.S. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 14p. (AIAA—88-0060). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010034/JAW.

From 26. AIAA aerospace conference; Reno, NV, USA (10 Jan 1988).

A multigrid based calculation procedure is presented for the efficient solution of the time-averaged equations of a turbulent elliptic reacting flow. The equations are solved on a non-orthogonal curvilinear coordinate system. The physical models currently incorporated are a two equation k-ε turbulence model, a four-step chemical kinetics mechanism, and a Lagrangian particle tracking procedure applicable for dilute sprays. Demonstration calculations are presented to illustrate the performance of the calculation procedure for a ramjet dump combustor configuration. 21 refs., 9 figs., 2 tabs.

36631 **(CONF-880180—1) An overview of problems to be resolved when meeting the 1991 bus particulate emissions standard.** Santini, D.J.; Schiavone, J.J. (Argonne National Lab., IL (USA); American Public Transit Association, Washington, DC). 1988. Contract W-31109-ENG-38. 37p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010088/JAW.

From 67. annual transportation research board meeting; Washington, DC, USA (11 Jan 1988).

An overview of the engine-fuel-technology-transition problems that may be created for transit systems if the strict 1991 bus particulate and nitrogen oxides emissions standards remain in force is presented. The estimates of costs and benefits of the two standards combined are called into question. The problems created for manufacturers by the particulates–nitrogen oxides trade-off and the tight technology development schedule are reviewed. By introducing the perspective that emissions from transit buses should be thought of in terms of emissions per passenger mile, the 1991 treatment of buses with respect to nitrogen oxides emissions is called into question. The unique spatial relationships among buses, downtown pedestrians, and metropolitan places of residence are taken into account when evaluating the differing effects of nitrogen oxides and particulates bus emissions. Based on this examination, the strict 1991 particulate emission standards are accepted as desirable, but it is asserted that very little reason has been demonstrated to support the strict 1991 nitrogen oxides standards for buses. 36 refs.

36632 **(CONF-880676—1) Development of encapsulated lithium hydride sink-side thermal energy storage for pulsed space power systems.** Morris, D.G.; Foote, J.P.; Olszewski, M.; Whittaker, J.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011496/JAW.

From Conference on thermophysics, plasma physics and lasers; San Antonio, TX, USA (27 Jun 1988).

Value analysis indicates that inclusion of thermal energy storage (TES) as an element in a pulsed space power supply will reduce the mass of the heat rejection system. A candidate design for the TES component utilizes lithium hydride (LiH) encapsulated in 304L stainless steel or molybdenum in a packed-bed configuration with a lithium or sodium-potassium (NaK) heat transport fluid. Critical concerns with this concept are the need to (1) accommo-

date shell stresses induced by volumetric expansion of the melting salt or surface gripping by the freezing salt and (2) minimize hydrogen loss through the shell due to LiH dissociation at high temperatures. Experimental observation of significant cracking of the LiH during cooling mitigates the first of these issues by providing a leakage path into the interior void as melting occurs at the salt-containment interface, thus allowing use of thin shells.

36633 (CTH-IVB—43) Energy consumption for vehicles and road authorities in densely populated areas. Influence from operation- and street standard . Wallman, C.G. (Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Highway Engineering). Apr 1986. 87p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752908/JAW.

The project consists of two parts. The first one explains the energy consumption of road users and road authorities due to maintenance standard and road standard. The work is mainly concentrated on determining how the pavement surface, wet, snowy or icy surface, and the road geometry influence on the driver's behaviour and the vehicle fuel consumption. The second part comprises construction of a computer-based system for computing road user consequences. Effects on the traffic of different maintenance measures can thus be computed.

36634 (CU—ERG763) Comparison of primary energy requirements for the operation of electric and conventional automobiles. Swinton, M.C. (Carleton Univ., Ottawa, Ontario (Canada)). Jun 1976. 44p. (CE—01483). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

As a part of the overall assessment of the potential role of electric automobiles in Canada, a study of the propulsive energy requirements of such vehicles has been undertaken. This entails a comparison of electric and conventional automobiles with respect to the energies required to produce a set amount of transportation work. The major processes are mining, refining, power generation, transmission or fuel transport, and vehicle operation. The energy conversion efficiencies that are characteristic of the energy supply industries, energy transportation, and vehicle operation of the electric and gasoline automobiles are estimated within the Canadian context. This allows a comparison of primary and secondary energy requirements of these vehicles for equal transportation tasks. The period of interest for this study is from 1980 to 2000. The system efficiency of the electric vehicle for urban travel is estimated to be 14% in 1980 decreasing to 12% in 1990 due to the decrease in electric power production efficiency. This may be compared to an estimated 7% system efficiency of an average Canadian automobile for urban travel. For highway travel, the corresponding figure is 23% in the 1980s compared to the conventional automobile's 13%. The vehicle system efficiencies were also examined for the province of Ontario in 1980. The operating efficiencies of 9.7% for the electric vehicle may be compared to 7% for the conventional automobile in urban travel. For highway travel, system efficiencies of 17% and 13% were obtained for the electric and gasoline vehicles respectively. 29 refs., 10 figs., 14 tabs.

36635 (DOE/TER—88/1) Transporation Energy Research: A current awareness bulletin. Smith, L.; Steele, B.C. (eds.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jan 1988. 53p. (PB—88-900901). NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008293/JAW.

Transportation Energy Research (TER) announces on a monthly basis the current worldwide information available on the engineering and design of energy-efficient advanced automotive propulsion systems and all aspects of energy conservation measures involving transportation.

36636 (HMC—031982) Energy conservation research and development opportunities in traffic operations. (Hickling (James F.) Management Consultants Ltd., Ottawa, Ontario (Canada)). Mar 1982. 29p. (CE—01499). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study has been commissioned in an attempt to direct future activities in energy conservation research in the area of traffic operations. The stated objective of the study was to review recent and on-going research to determine the potential for conserving energy through improved traffic operations measures and to identify and recommend future research needs and potential payoffs from the implementation of research findings. In order to achieve this objective, a review was undertaken of current conservation techniques and North American research in progress. A seminar was held attended by a group of traffic operations researchers, practitioners and administrators. In developing strategies for fuel conservation, there are basically two actions that can be taken. The first attempts to increase the fuel efficiency of the vehicles using the road system while the second strategy attempts to alter the demand for vehicle use (or shift demand to more fuel efficient modes). It was felt that the most important areas to be researched with respect to fuel conservation through traffic operations were technology transfer, development of uniform standards for field trial evaluation, sensitivity analysis of various conservation measures, demonstration and evaluation of conservation techniques, development of traffic control systems and hardware, research on providing route information to drivers, and development of signal timing strategies. 6 figs., 3 tabs.

36637 (ISL/CR—4353) Fuel consumption guide quantitative evaluation: methodological report. (International Surveys Ltd., Toronto, Ontario (Canada). Customer Research Div.). Jul 1983. vp. (CE—01425). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents only the methodological details of the quantitative phase of the evaluation of the 1983 Fuel Consumption Guide conducted on behalf of Transport Canada. The Guide is available from Transport Canada and the study was conducted among car drivers who had requested it. Two hundred completed interviews with people who had read the Guide were sought in each of six regions of the country. Selection details and a contact record are presented for eastern and western Canada. Sample questionnaires in English and French are included in the appendix. 4 tabs.

36638 (ORNL/CON—244) Technology transfer for DOE's Office of Transportation Systems: Assessment and strategies. Snell, S.A.; Brown, M.A.; Zerega, A.M. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 105p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010760/JAW.

This report reviews and assesses the technology transfer effort of the US DOE's Office of Transportation Systems (OTS) and offers recommendations for future technology transfer activities. The OTS technology transfer strategy calls for maximum industry involvement in both the identification and solution of R and D problems. This strategy is supported not only by utilizing industry as the research contractor, but also through a variety of other technology transfer activities. After reviewing the technical accomplishments of the Office, the report describes some of the barriers that inhibit commercialization of these accomplishments. Primary, secondary, and spin-off audiences for OTS R and D are then characterized. An inventory of recent OTS technology transfer activities follows and is supplemented by nine detailed case studies of technology transfer. These case studies represent five distinct approaches to technology transfer and a wide array of mechanisms including: contracting to industry, licensing, demonstration projects, user facilities, and financial incentives. The report ends with a list of recommended future technology transfer activities.

36639 (VTT-TIED—670) Speeds of company cars. Alppivuori, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1987. 66p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753354/JAW.

The speed of passenger cars driving outside queues within different speed limit zones as well as how the ownership of the car influences the driving speed were investigated. There were considerable differences in the speeds between the different car models.

Within the speed limit zones of 100 and 120 km/h medium-sized and large cars drive faster than the small ones. Within the speed limit zones 50 and 80 km/h this could not be observed. The age of the car influences the driving speed with 0.8-1 km/h per year within the speed limit zones 100 km/h and 120 km/h. Thus a five years old car, which corresponds to the middleage of our car park, drives 4-5 km/h slower than new cars. The influence of age could no be observed within the other speed limit zones. Company cars are an average 2-3 years younger than cars in private ownership. When the age correction was taken into consideration, it could be stated that the speed of company cars exceeded with 4 km/h that of the private cars within the speed limit zone 100 km/h. This difference could not observed within lower speed limit zones.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 35907, 35922, 36151, 36560, 36680, 36722, 36741, 36923, 37136, 37655, 37817

36640 (CONF-880184—Exc.-Summs.) Adsorption for exhaust purification. Summaries. Kienle, H. von; Zimmermann, H.; Heinegaard, C. (Deutsche Gesellschaft fuer Chemisches Apparatewesen, Chemische Technik und Biotechnologie e.V. (DECHEMA), Frankfurt am Main (Germany, F.R.)). 1988. 4p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88770214/JAW.

From 343. DECHEMA colloquium: adsorption for exhaust air purification; Frankfurt am Main, F.R. Germany (21 Jan 1988).

The abstracts of 3 contributions to the meeting are given, the contents of which deal with specific adsorption processes and adsorbents with particular regard to solvent recovery.

36641 (CONF-8603244—) Better utilization of raw materials and energy in the textile industry. Proceedings. (Verein Deutscher Ingenieure (VDI), Duesseldorf (Germany, F.R.). Fachgruppe Textil und Bekleidung). Mar 1986. 204p. (In German). NTIS (US Sales Only), PC A10. Order Number DE88770211/JAW.

From VDI-ADT annual meeting on better utilization of raw materials and energy in the textile industry; Reutlingen, F.R. Germany (14 Mar 1986).

This book contains the manuscripts of the papers presented at the conference on 'Better utilization of raw materials and energy in the textile industry' as handed in by the authors. 3 papers are indexed separately in the database.

36642 (CONF-8603244—, pp 151-164) Heat recovery possibilities in air-nozzle looms. Schmidt-Burr, P. (PSB-Consulting G.m.b.H., Muenchen (Germany, F.R.)). Mar 1986. (In German). NTIS (US Sales Only), PC A10. Order Number DE88770211/JAW.

From VDI-ADT annual meeting on better utilization of raw materials and energy in the textile industry; Reutlingen, F.R. Germany (14 Mar 1986).

Compressed air is certainly the best transport and guidance medium for the weft yarn. Up to 600 weft yarns over 3 m weaving breath are possible. The fact that no maintenance is necessary is the most outstanding advantage in comparison to conventional mechanic gripper shuttle looms. The major part of the drive energy needed, i.e. 60-65% is needed for providing the compressed air for the air-nozzle loom. The higher demand of driving energy, i.e. 25 to 50% more than that of a gripper shuttle loom is made up for by an increased weaving output which, as a rule, is higher than the additional energy demand. The fact that most of the driving energy is needed by the air compressor has the additional advantage of permitting easy utilization of the waste heat.

36643 (CONF-8603244—, pp 181-189) Possibilities of energy saving by modern speed regulating AC motors. Waldinger, H. (Siemens A.G., Erlangen (Germany, F.R.)). Mar 1986. (In German). NTIS (US Sales Only), PC A10. Order Number DE88770211/JAW.

From VDI-ADT annual meeting on better utilization of raw materials and energy in the textile industry; Reutlingen, F.R. Germany (14 Mar 1986).

Static-converter fed, r.p.m.-controllable drives can help to save energy in many areas of the textile industry. Different types of drives (SIMOREG and SIMOVERT) are available. The profitability of such an investment can be easily determined once the operational data of the working process are known.

36644 (DOE/BP/71980—T1) Calibration of irrigation flow meters. Trimmer, W.L. (Oregon State Univ., Corvallis (USA). Dept. of Agricultural Engineering). Feb 1988. Contract AI79-86BP71980. 50p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010992/JAW.

Several meters working on the Doppler principle were tested. The Doppler meters depend on reflections from particles or bubbles in the fluid to measure velocity. Although they were linear, they were too inaccurate and inconsistent. Two meters working on the transit time principle were tested and worked very well. These meters measure upstream and downstream transit times for signal reflections from the inner pipe surfaces. However this type of meter is available at present only for permanent installations, not as a survey meter. Finally, the currently used Hall meters were calibrated and recommendations were made as to their proper use. The report recommends that an effort be made to develop a transit time meter in a portable configuration for irrigation survey work. 14 figs., 5 tabs.

36645 (DOE/CE/40699—T8) Energy conserved and costs saved by small and medium-size manufacturers: [Final and annual report], 1985-86 EADC [Energy Analysis and Diagnostic Center] program period. Kirsch, F.W. (University City Science Center, Philadelphia, PA (USA)). Mar 1988. Contract FC01-84CE40699. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008815/JAW.

The Energy Analysis and Diagnostic Center (EADC) program continues to provide energy-conserving and cost-saving assistance in the plants of small and medium-size manufacturers. This report presents the results of energy audits in 300 such plants carried out by ten EADCs during the 1985-1986 program period. Also included are the results obtained during 1987 from manufacturers who implemented 1,267 of the EADCs' recommendations from the preceding year.

36646 (DTH-LET-RE—87-5) Ground water-source heat pumps. Partial report 6. Utilization of ground water as heat source for heat pumps. Niemi Soerensen, S.; Qvale, B. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik). Oct 1987. 103p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752909/JAW.

This report is worked out on the basis of experiences obtained from 189 Danish groundwater heat pump plants in the period 1982-1985. The experiences are collected through a questionnaire within the research programme of the Danish Ministry of Energy (EFP82). Besides the experiences obtained by the questionnaire the recent experiences from a groundwater heat pump test plant at the Technical University of Denmark are included in the report. The report gives a review of experiences with 189 Danish groundwater heat pump plants, recommendations for instrumentation of plants and recommendations for the establishment of the groundwater circulation system. These recommendations aim to avoid the difficulties experienced with this type of heat pump plants. Furthermore the report gives some recommendations for the instrumentation of plants for managerial economics and supervision. Finally guidelines are given for calculations of the thermal load on aquifers used as heat source for heat pumps. These guidelines can at present only be stated as preliminary because of lack of field experience.

36647 (EGG—2539) A comparative economic evaluation of industrial heat pumps: Part 2, Addendum to report EGG-2408. Bliem, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1988. Contract AC07-76ID01570. 98p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88011701/JAW.

This report extends the findings of a study on the cost of delivering process heat with state-of-the-art heat pump systems originally reported in EGG-2408. The original report considered heat pump of a 30 MM Btu/h size, receiving heat from a waste-heat source at 220{degree}. This report extends the work to a 10 MM

Btu/h size and to waste-heat sources at 180{degree} and 320{degree}F. Results of the original study are being used to define economic performance which must be met or improved upon by advanced heat pump concepts in order to warrant Department of Energy (DOE) development support. This work will extend the range of applicability to other sizes and waste-heat source temperatures. Sixteen heat pumps systems were configured for relative cost comparisons for each waste-heat source and size. These systems consisted of electrically-driven, prime energy-driven, and waste energy-driven reverse Rankine cycle heat pumps of the open, semiopen, and closed type. In addition, a waste energy-driven absorption heat pump was analyzed. A conceptual design of each system was created using the off-the shelf components generally available to engineering firms. The performance of each system was assessed, the major components sized, and the installed cost determined. Maintenance costs were estimated. Finally, the relative cost of energy delivered by each system was estimated, and the cost of delivery heat with state-of-the-art heat pumps was determined.

36648 **(GAO/NSIAD—87-88BR) Hazardous waste: Abandoned disposal sites may be affecting Guam's water supply.** (General Accounting Office, Washington, DC (USA)). 1987. 20p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

In 1978 Anderson Air Force Base in Guam discovered that the base's drinking water was contaminated with the cleaning solvent trichloroethylene, a suspected carcinogen. The sources of the contamination were old, abandoned landfills where the solvents had been disposed. Testing of the drinking water has been sporadic and has not included water consumed by portions of the installation populace. Anderson officials established procedures to test water samples monthly at different points in the water distribution system and if the test results indicate contamination, corrective action will be taken to make the drinking water safe, or the wells will be shut down.

36649 **(GAO/NSIAD—87-164BR) Hazardous waste: Tinker Air Force Base is making progress in cleaning up abandoned sites.** (General Accounting Office, Washington, DC (USA)). 1987. 23p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Tinker Air Force Base in Oklahoma is a major generator of hazardous waste. Problems with the generation, storage, and disposal of the waste have resulted in the contamination of several sites on base. To clean up the contamination, Tinker established an Environmental Action Group to increase its responsiveness to hazardous waste issues and to act as a clearinghouse for all environmental actions. It also established a single point of contact for environmental issues by creating a new Environmental Management Directorate; created a Technical Working Group to establish agenda items concerning its Installation Restoration Program, such as possible cleanup alternatives; and contracted with the Army Corps of Engineers for completing the Installation Restoration Program on a cost-reimbursement basis. However, remedial actions are slow and much needs to be done.

36650 **(GAO/NSIAD—87-200BR) Hazardous waste: Siting of storage facility at Kelly Air Force Base, Texas.** (General Accounting Office, Washington, DC (USA)). 1987. 10p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report provides information on whether the hazardous waste storage facility at Kelly Air Force Base meets Resource Conservation and Recovery Act, state, and Air Force siting requirements; on whether the Air Force or the Defense Reutilization and Marketing Office selected the best site available to protect the public and to preserve good public relations with the community; on whether the Air Force, Kelly Air Force Base, or the Defense Logistics Agency adjusted siting standards as a result of the adverse publicity the hazardous waste facility has generated; and on whether Kelly Air Force Base is revising its hazardous waste management organization so that it is similar to the organizations at Tinker and McClellan Air Force Bases.

36651 **(GAO/RCED—87-127) Toxic substances: Abandonment of PCBs demonstrates need for program improvements.** (General Accounting Office, Washington, DC (USA)). 1987. 33p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

In April 1985, SED, Inc, a PCB handling and disposal company, went out of business, abandoning approximately 7 million pounds of the highly toxic materials and equipment at its sites in Greensboro, North Carolina, and Hillsboro, Ohio. The Environmental Protection Agency did not act to prevent SED from continuing to acquire large amounts of PCB materials while it only disposed of a small portion and EPA inspections of SED operations were not frequent or forceful.

36652 **(GAO/RCED—87-132FS) Hazardous waste: Information on EPA's proposal to delete chemicals from groundwater monitoring.** (General Accounting Office, Washington, DC (USA)). 1987. 20p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Information is not readily available on the quantities of hazardous waste being disposed of that contain 42 toxic chemicals. Twenty-nine of the 42 chemicals are highly toxic and over one third might possibly be found at hazardous waste land disposal facilities. In some instances, short-term exposure to the 29 chemicals in pure form could lead to death or permanent injury. In addition to toxicity, some of the chemicals are known or are suspected of having other harmful effects on humans or animals. Owners/operators of hazardous waste land disposal facilities are required to initially monitor the characteristics of groundwater for detection of contamination. Despite this requirement, the Environmental Protection Agency proposed deleting the 42 chemicals from testing - a proposal which elicited queries from two congressional committees. So far, EPA's final regulations on the proposal have not yet been issued.

36653 **(GAO/RCED—87-156FS) Water quality: Pollution of San Francisco Bay and the Sacramento-San Joaquin Delta.** (General Accounting Office, Washington, DC (USA)). 1987. 36p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Pollution in the San Francisco Bay and the Sacramento-San Joaquin Delta is a problem but the full extent of the problem and its impact on the overall health of the bay is not fully known. GAO found that federal wastewater dischargers contribute less than 1 percent of the total wastewater directly discharged in the bay and delta. Hazardous waste leaks from federal facilities have significantly less effect on overall water quality compared with other sources of bay and delta pollution. Federal studies are underway to better identify and quantify bay and delta pollution sources and to set priorities among pollution problems and develop a plan to enhance the bay's and delta's environmental health.

36654 **(IVO-A—08/87) Potential uses of infrared heating and drying in the mechanical wood processing industry.** Kautto, J.; Tarvainen, V. (Imatran Voima Oy, Helsinki (Finland)). 1987. 83p. (In Finnish). NTIS (US Sales Only), PC A05. Order Number DE88752816/JAW.

The report deals with the theory and applications of infrared (IR) heating and drying processes in the mechanical wood processing industry. In the mechanical wood processing industry, IR drying is mainly used for the drying and hardening of surface finishing agents, such as varnishes and paints and for the preheating of surfaces. In the gluing of various coatings, IR technique is used for pre-evaporation of the glue and for the heating of base board. Other applications include pre-evaporation and activation of the edging strip glue, preheating of the laminate before bending in post-forming and pre-evaporation of the glue in the scarf-jointing of veneer sheets. IR technique can also be applied to increase the production capacity economically, for instance pre- or redrying in the of veneer. The wood industry uses short-wave, medium-wave and long-wave IR radiation in its applications; medium-wave infrared is most commonly used. Medium-wave IR radiation is well absorbed in wood, water and surface finishing agents to be used. The heating effect of medium-wave IR radiators is suitable for several purposes in the wood industry; medium-wave IR ovens warm up and cool

down rapidly compared with convection dryers. Short-wave IR radiation is suitable for surface finishing agents allowins rapid drying and requiring high amount of energy, such as water-based paints and for applications requiring high penetration of the radiation into the material to be heated. Long-wave IR radiation has only few uses and it is often economical to replace long-wave IR lines by medium-wave IR lines. In IR drying the tendency is to adopt more and more efficient IR equipments. The use of infrared will continue to increase; however, it is difficult to evaluate the potential for development, because on the market IR technique competes with vertical dryers and with ultraviolet equipments.

36655 (NEI-DK—63) Reducing electricity consumption in American type combined refrigerator/freezer. Pedersen, P.H.; Schjaer-Jacobsen, J.; Norgard, J.S. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). May 1986. 14p. (CONF-8605334—2). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752836/JAW.

From 37. annual international appliance technical conference; Lafayette, IN, USA (6 May 1986).

At the Technical University of Denmark work was started early in 1985 with the purpose of reducing energy consumption of American style 20 cubic feet combined refrigerator/freezers. The work is sponsored by two California utilities. The goal is to reduce energy consumption to 480 kWh/year or one half of what best 1984-models use while maintaining automatic defrosting and other services. Outer dimensions remain the same, but the inner volume is allowed to be reduced to 18 cubic feet. Some prototypes are being built by employing European principles with separate refrigerator and freezer circuits (two-compressor system). A special fresh food evaporator with additional heat capacity is used together with an integrated condenser placed at the inner side of the outer cabinet. The latter reduces condenser temperatures and furthermore saves electricity for the antisweat heaters. Insulation thickness is slightly increased and other improvements are implemented. The separation of the two refrigeration systems considerably reduces the frost build-up on the freezer evaporator and thereby the need for electricity consuming defrosting. The fresh food evaporator is defrosted automatically without consuming electricity. Calculations show that it is possible to reduce the electricity consumption to approximately 480 kWh/year.

36656 (PB—88-184890/XAB) Industrial boiler furnace sorbent-injection algorithm development. Final report. Maddox, J. (Radian Corp., Research Triangle Park, NC (USA)). Mar 1988. 52p. NTIS, PC A04/MF A01.

This report describes the development of a performance and control-cost algorithm for the Industrial Combustion Emissions (ICE) Model, one of four stationary source emission and control cost forecasting models developed by EPA for the National Acid Precipitation Assessment Program (NAPAP). The ICE Model projects air pollution emissions (sulfur dioxide (SO_2), sulfates, nitrogen oxides, and particulate matter), cost, and fuel mix for industrial fossil-fuel-fired (natural gas, distillate and residual fuel oil, and coal) boilers by state and year (1980 baseline, 1985, 1990, 1995, 2000, 2010, 2020, and 2030). The algorithm enables the ICE Model to consider, on an economic basis, the use of hydrated lime injection for SO_2 control when a SO_2 emission reduction strategy is implemented. The algorithms described have been incorporated into ICE Model Version 6.0.

36657 (PB—88-197579/XAB) Resource recovery and waste reduction: fourth report to Congress. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Aug 1977. 162p. (EPA—530/SW-600). NTIS, PC A08/MF A01.

See also PB—88-174677.

The report reviews current status of resource recovery and waste reduction in the United States and presents new findings from Environmental Protection Agency (EPA) studies, investigations, and technology demonstration projects.

36658 (STEV-FVE—87-6) Heat pumps in Industry. Operating experiences from 12 plants. Bergstroem, U.; Larsson, R. (Statens Energiverk, Stockholm (Sweden)). May 1987. 86p. (In Swedish). NTIS (US Sales Only), PC A05. Order Number DE88752959/JAW.

This report describes twelve industrial sites where heat pumps are used to recover waste heat from the process. Operating experience has generally been favourable. The most serious problem has been high frequency of motor faults. Control problems have been encountered in some of the installations, often due to attempts to control both the evaporator and the condenser side of the heat pumps. Most of the users had specified and purchased the equipment themselves. In fact, this has been essential, as the heat pumps have had to be matched to relatively complex existing systems. The heat pumps have normally been installed to recover process heat that would otherwise have been discarded. With few exceptions, the heat has been used for space heating and domestic hot water production. Performance measurements made indicated that the heat pump systems have largely lived up to expectations in terms of performance and availability. In some cases, the quality of owners' own monitoring of performance was poor.

36659 (STEV-FVE—87-7) Power levelling of district heating systems. Johnsson, H. (Statens Energiverk, Stockholm (Sweden)). Mar 1987. 86p. (In Swedish). NTIS (US Sales Only), PC A05. Order Number DE88752960/JAW.

The aim of the project is to describe and compare different methods of power levelling and heat storage in district heating systems. Hot water cisterns are well known for storage. Different systems are described and evaluated. Operational statistics from district heating and users are reported. (G.B.).

36660 (STU—81-4593) Anaerobic treatment of CTMP effluent. Boman, B.; Almemark, M.; Bergstroem, R. (Swedish National Board for Technical Development, Stockholm; Swedish Environmental Research Inst., Stockholm). Jun 1986. 153p. (In Swedish). (STU—82-5792; IVL-B—830). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752973/JAW.

Experiments with anaerobic treatment of a CTMP effluent in a contact reactor and in a submerged filter (one-stage processes) were carried out on a pilot-plant scale at the pulp and paper mill of Rockhammar. The treatment process was also tried with the two reactors connected in series. In addition, comparative experiments with laboratory filters were performed. The experiments on a pilot-plant scale gave a maximum COD reduction rate of 70%. The COD reduction rate of the anaerobic filter proved to be completely independent of the load within the interval studied (<or= 6 kg COD/m/sp3/,d), while the COD reduction rate of the contact reactor decreased linearly with increasing load. The COD reduction rate of a full-scale treatment plant will also depend on the effectivity of the sludge separation process necessarily following the anaerobic reactor. Sedimentation experiments indicated that the residual concentration of suspended solids will be around 900 mg SS/l. Since the suspended material contains about 2 kg COD/kg one may expect a full-scale plant to give a real COD reduction of about 58%. The experiments suggest, that there exists a linear correlation between the specific methane production rate and the load with a slight negative slope within the load interval studied (0.5-6.5 kg COD/sbtot//m/sp3/,d). In our case specific methane production rates within the interval 0.1-0.2 m/sp3/ CH/sb4/ COD were obtained (COD=CODtot,in - CODdissolved,out). On the basis of our results and experiences the most likely explanation for the relatively low methane yields seems to be some bactericidal organic compound(s) within the group of extractives. The sulphur-reducing bacteria are very sensitive to disturbances and toxicity. The experiments suggest, that these bacteria may serve as indicator organisms for the 'level of disturbance' in the reactor, and that the filter is less sensitive to disturbances than the contact reactor. (authors).

36661 (STU—83-3176) Optimum chemicals recovery system. A first report. Theliander, H. (Swedish National Board for Technical Development, Stockholm). Aug 1986. 180p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88752975/JAW.

The chemical recovery system of a sulphate pulp mill is probably one of Sweden's largest inorganic processes with great technical and economic importance. The section that comprises the smelt from the recovery boiler to the white liquor produced is a part of the process on which relatively few research contributions

have been published. With the purpose of finding an energy optimal process solution for this section, a system analysis study has been carried out. Thereby it was found necessary, in order to elucidate the potential possibilities that different procedures would result in, both to study the present process technique and to simulate possible improvements. Within the frame of the present work special emphasis was attributed to the three following parts: system analysis studies of present processes, theoretical studies of different process procedures, and density of aquous solutions of salts An important conclusion of the present system analysis study, based on the evaluation of three different mill recovery systems, is that all the systems have a negative exergy effiency. This means that the mill recovery systems investigated ought to produce energy and not, as the case is today, consume energy. The theoretical studies showed that the energy efficiency could even be increased with a factor of about 2.5, compared with the mill recovery systems of today. The amount of energy that could thereby be saved in the sulphate pulping process is of the same order of magnitude as the energy consumed in the lime kiln.

36662 **(SVF—276) By-products from fluidized beds - characteristics with respect to disposability and re-use.** Nilsson, C. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Aug 1987. 119p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753348/JAW.

In this investigation, materials from four different fluidized bed plants, based on differing fundamental designs, have been dealt with. These include: -the atmospheric bubbling bed (pilot plant, 10 MW), -the circulating bed (district heating plant, 40 MW), -the pressurized bed (pilot plant, 12 MW), -the multi bed (pilot plant, 2 MW). In the investigations, important physical characteristics as well as chemical compositions including trace-metal content have been accounted for. Tests show that the leaching out of trace elements generally occurs slowly, probably due to the high alkalinity of the materials. The salts, as expected, leach out relatively quickly and certain materials contain traces of sulphite which contributes to an increased Chemical Oxygen Demand value in the leachate. The investigation shows that especially those materials which are not completely combusted possess poorer frost and physical characteristics, which is assumed to depend on the fact that the air bubbles needed to take up the swelling movements are not beeing admixed to the normal extent in these materials. Additionally, materials with a remarkably high content of free lime display impaired physical characteristics. The general consequence of this is that fly ash usually possesses a poorer strength than bed ash.

36663 **(VTT-TIED—791) Laser applications in the concrete industry and concrete construction.** Seren, K-J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Nov 1987. 58p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753000/JAW.

The publication discusses on the basis of literature studies the possibilities of applying laser technology in the concrete industry and to concrete construction. The principles and general application areas of laser technology are briefly presented and examples of laser applications relating to concrete and concrete structures are given. The publication concludes with some ideas about potential applications in the concrete industry and various viewpoints concerning the needs for future research. The laser cutting method has been used experimentally to cut hardened concrete. The method however, is not at present economically viable in production. Laser measuring equipment can be used in the concrete industry, especially for dimensional measurements. In the near future, research should focus on an extensive survey of measurement requirements and possible measuring methods in the concrete industry.

36664 **System for conversion between the boundary representation model and a constructive solid geometry model of an object.** Christensen, N.C.; Emery, J.D.; Smith, M.L. (to Dept. of Energy, Washington, DC). US Patent 4,736,306. 5 Apr 1988. Filed date 29 Apr 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method of manufacturing an object from a boundary representation thereof is described comprising: cleaving the boundary representation of the object, which represents the object only by zero, one or two dimensional features thereof, into elemental atomic geometrical units; assembling the I-bodies into assemblies having atomic geometrical forms which collectively form a constructive solid geometry representation of the object usable for manufacturing thereof; utilizing the constructive solid geometry representation of the object to develop machine instructions for instruction one or more machines in a manufacturing process; and controlling the machines to perform operations under control of the instructions to manufacture at least a portion of the object.

36665 **(DOE-tr—88-10) Energy conservation.** (USDOE, Washington, DC). 1988. Translation source information not available. 61p. NTIS, PC A04/MF A01;3.

Various research programs of energy conservation and materials recovery are briefly described. Topics include food drying,electrolysis, incinerators, optimization of dewatering equipment, membrane technology, and separation processes. Many programs are discussed in these areas. (CBS)

36666 **Development of the remedial action priority system: An improved risk assessment tool for prioritizing hazardous and radioactive-mixed waste disposal sites.** Whelan, G.; Strenge, D.L.; Steelman, B.L.; Hawley, K.A. (Pacific Northwest Lab., Richland, WA (US)). pp 432-437 of Management of uncontrolled hazardous waste sites. Silver Spring, MD; Hazardous Materials Control Research Institute (1985). (CONF-8511122—). Contract AC06-76RL01830.

From 6. national conference on management of uncontrolled hazardous waste sites; Washington, DC, USA (4 Nov 1985).

The Remedial Action Priority System (RAPS) represents a methodology that prioritizes inactive hazardous and radioactive mixed-waste disposal sites in a scientific and objective manner based on limited site information. This methodology is intended to bridge the technology gap that exists between the initial site evaluation using the Hazard Ranking System (HRS) and the time-consuming process of actual field site characterization, assessment and remediation efforts. The HRS was designed as an initial screening tool to discriminate between hazardous waste sites that do not and those that are likely to power significant problems to human health, safety and/or the environment. The HRS is used by the U.S. EPA to identify sites for nomination to the National Priorities List (NPL). Because the HRS is not designed to evaluate sites containing radionuclides, a modified Hazard Ranking System (mHRS) addressing both hazardous and radioactive mixed wastes was developed by Pacific Northwest Laboratory (PNL) for the U.S. Department of Energy (DOE). Neither the HRS nor the mHRS was designed to prioritize sites that are nominated to the NPL according to their potential risks. To provide DOE with a better management tool for prioritizing funding and human resource allocations for further investigations and possible remediations at its inactive waste sites, PNL is developing the risk assessment methodology called RAPS. Use of RAPS will help DOE ensure that those sites posing the highest potential risk are addressed first.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 35923, 35928, 36026, 36183, 36185, 36246, 36461, 36511, 36512, 36513, 36657, 37411

36667 **(AS—EMR8) District heating for small communities.** (Acres Shawinigan Ltd., Toronto, Ontario (Canada)). Jan 1977. 115p. (CE—01491). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study addresses the problem of providing district heating for smaller communities in Canada. In February, 1976 a report titled "District Heating Study", issued by the Ontario Ministry of Energy, addressed the problem of providing district heating for a town of 70,000 people and used the proposed new town of North Pickering as a model. The present study uses the same basic parameters and assumptions as the Pickering study but considers both new and existing communities of 20,000, 10,000 and 2,500 people respectively. A comparison is made between the costs of providing

heat by individual heating systems and the costs of district heating using central fossil fuel fired boilers. The study concludes that there is an economic case in favour of district heating for new communities as small as 2,300 people incorporating an industrial component or 4,500 people for purely residential communities. Retrofitting district heating to existing communities is considerably more expensive and a very high percentage of the potential heating load must be connected to the district heating system to make the scheme economically viable. 1 ref., 9 figs., 79 tabs.

36668 (AS—EMR10) Gas turbines and district heating. (Acres Shawinigan Ltd., Toronto, Ontario (Canada)). Feb 1977. vp. (CE—01492). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study, commissioned by the Department of Energy, Mines and Resources, addresses the problem of utilizing gas turbines in conjuction with distict heating schemes. In February, 1976 a report titled "District Heating Study" was issued by the Ontario Ministry of Energy. That study addressed the problem of providing district heating from nuclear and/or fossil fuel sources for a town of 70,000 people and used the proposed town of North Pickering as a model. The present study uses the same model and considers the application of various combinations of gas turbine generators with heat recovery equipment and auxiliary boilers to provide the electrical and heat energy requirements of the model community. The study concludes that there is a technical and economic case for gas turbine based schemes providing both heat and electrical energy when compared with the separate supply of these two services. 37 refs., 33 figs., 38 tabs.

36669 (BFR-R—53-1986) Recovery of heat losses from district heating mains by heat pumps. Types of mains and system optimisation. Baerring, M.; Rosenberg, M. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 90p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752883/JAW.

The objective of this work has been to perform technical and economic optimisation of the design and siting of a ground collector intended for use with a heat pump to recover losses from district heating mains. Calculations indicate that such a scheme would be economically viable only if an existing heat pump was available and if the price of electricity was relatively low. (authors).

36670 (CONF-8805107—1) Potential of converting MSW [municipal solid waste] to useful fuels. Mallya, N.; Helt, J.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010040/JAW.

From 13. national waste processing conference and exhibit; Philadelphia, PA, USA (1 May 1988).

Pyrolysis of municipal solid waste (MSW) has the potential of helping solve two problems: (1) the disposal of the waste generated by our society, and (2) the need for additional sources of energy. Experiments on the pyrolysis of MSW components in a bench-scale reactor are reported. The liquid and solid products formed are analyzed for physical and chemical properties to help determine their potential as useful fuels.

36671 (DOE/CE/15294—T1) The ultra pure water system: Final report. Karlson, E.L. (Karlson (Eskil), Erie, PA (USA)). Mar 1988. Contract FG01-86CE15294. 19p. Eskil L. Karlson, Life Support Systems, Inc., 4634 State Street, Erie, PA 16509. Order Number TI88010812/JAW.

The design, building and the testing of an Ultra Pure Water Generation System that was funded by the Department of Energy (DOE) after first being evaluated by the National Bureau of Standards is covered. This system will accept water that is highly polluted with both suspended and dissolved solids. The purification and sterilization is performed in stages. As the water is pumped in, it is first forced through a set of three filters. These filters collect 99% of the particles. The water is then sent through the ion-exchange section which extracts 99.9% of the dissolved solids. The water is then sent through a mixed ion-exchange column and into the the last micro filter. It then is sent to a two gallon holding tank. While in the tank the pure water is polished with ozone gas. The flow through the complete purification system is 2 gallons per minute, therefore, its exposure time to ozone in this holdup tank is about 5 minutes. During the time any oxidizable matter, bacteria or viruses left will be destroyed. An important cycle of this unit is the back flush system. After each use of the water purification system, the unit reverses the flow of water through the larger particle filters.

36672 (DOE/CE/26550—T2) Feasibility study for district heating and cooling for the City of Des Moines, Iowa. (Des Moines Engineering Dept., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Design Research Inst.). 1987. Contract FG01-86CE26550. 219p. NTIS, PC A10;3. Order Number DE88009087/JAW.

The Des Moines District Heating and Cooling Assessment Study shows that: District heating and cooling are technically feasible, with the Iowa Power Plant as a primary energy source with cogeneration and three types of distribution media: high and low temperature water for heating and chilled water for cooling. District heating is economically feasible, but additional studies are needed for cooling. In general, district cooling should be considered mainly in addition to heating, except perhaps for small systems. To be economically feasible, the large consumer/producers (Capitol Complex, Drake University, and the four hospitals) should be included, and a strong marketing effort conducted to induce a large portion of major downtown buildings to join the system. To help in marketing, piping connections and system conversions in the buildings or groups of buildings should be included in the overall construction project and its financing. Further consideration should be given to construct the metro refuse burning plant as an additional energy source for district heating and cooling, or to have this function take place at the Iowa Power Plant with fluidized-bed boilers. The large consumer/producers can reduce the peak load conditions and enjoy reduced interruptible rates. The Iowa Gas Company could be considered as an alternate energy source, with a downtown location for a DHC plant.

36673 (DOE/CE/63471—T6) A plan for Central Vermont Community Action Council to form a new energy/housing services unit. (Woodbury Organization for Research and Development (USA)). 30 Aug 1987. Contract FG01-86CE63471. 119p. NTIS, PC A06;3. Order Number DE88007578/JAW.

This plan for Central Vermont Community Action Council, Inc. (CVCAC) to form an Energy/Housing Services Unit (EHSU) will prepare it for the challenges that it must meet in the late 1980's and early 1990's if it is to properly serve the interests of the poor and disadvantaged in its 56 town operational area. Potential for-profit business areas for the EHSU to pursue were examined but always from the perspective of how they could benefit CVCAC and its clients and not as an end unto itself. With these criteria in mind, and taking into account current market forces, major business ventures into infra-red thermography, storm window manufacturing, and fee-for-service weatherization were found to be impractical for CVCAC to pursue at this time. It is the recommendation of this plan that fee-for-service weatherization of multi-family subsidized housing be pursued as well as a small-scale increase in storm window production with sales to private purchasers. This plan also recommends that CVCAC acquire the FHC family housing project.

36674 (DOE/EA—0079) Energy Conservation Grants Program for schools, hospitals, and public buildings: Environmental assessment. (USDOE Assistant Secretary for Conservation and Solar Applications, Washington, DC). Mar 1979. 36p. NTIS, PC A03. Order Number DE88008858/JAW.

This EA analyzes the environmental impacts of the grants program which was established by Title III of the National Energy Conservation Policy Act (NECPA) (PL 95 to 619).

36675 (HMA—EMR7) A study of the economic implications of optimal building insulation on district central heating systems. (Hedlin, Menzies and Associates Ltd. (Canada)). Apr 1976. 104p. (CE—01489). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An economic and engineering study has been made of providing space heating to the proposed new Pickering (Ontario) Townsite testing both conventional, individual heating systems and centralized district heating systems, using heat from a nuclear power plant and also from non-nuclear sources. In this study the relative economics of individual and district heating sytems are examined under updated insulating standards that are considered more appropriate for the energy cost that exists in 1976. The basic conclusion drawn from the study is that the optimal insulation standards reduce overall demands for heat by over 40%. This results in a 5% increase in unit costs of heat because of lower density of demand but clearly the overall demand decrease more than offsets this cost change. The design load for the whole township is reduced by 41%; of this reduced load, 71% is accounted for by lowering the number of air changes and 29% by improved insulation. In capital items, the economics of district heating system improves relative to conventional, individual heating system under optimal conditions, given that the net incremental costs are only $4.29 million for the former but $39.03 million for the latter. The investment costs of distribution per dwelling unit for low and medium density housing is relatively insensitive to reduced densities of demand under optimal conditions. For high density housing, costs and demand changes seem to be directly related. 27 figs., 48 tabs.

36676 (JFM—EMR8) A study of the potential industrial use of district heating. (Malaren (James F.) Ltd. (Canada)). Dec 1976. 44p. (CE—01490). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study was designed to obtain detailed information on the estimate of the industrial energy demand that might be satisfied by a district heating system. A stratified sample of industries in Winnipeg was surveyed in order to obtain an estimate of the quality of the energy used in its final form. From the information it was possible to obtain an overview of the potential for supplying that energy from a district heating system. The projected heat use density in a hypothetical new industrial area consisting of the study group of industries, if only obvious uses are considered, would likely be economically acceptable for a hot water or low pressure steam district heating system. If moderate limits are placed on the permitted ratio of vacant land to building gross floor area, and incentives or deterrants are offered to install energy systems adaptable to district heating, the projected district heating load would be increased to the point where such a district heating system would prove economically desirable. Although the district heat load could be increased further, this would not likely be cost-effective. In general, the results agree with the more general studies available for Canada and suggest that it would be economically feasible to provide at least half the energy used by the average manufacturer in this way. Although a high energy intensive industry was not included in the study, the location of one within the new industrial 'park' would have greatly improved the economic feasibility of an overall district heating system. The study, nevertheless, offers further evidence of the practicability of district heating in a Canadian environment. 14 refs., 3 figs., 9 tabs.

36677 (KTM/E-D—142) Using wood and peat fuels more effectively in district heating plants. Flyktman, M.; Mietinen, M.; Seppaenen, V.; Vesterinen, R. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 112p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752828/JAW.

The aim of this study was to develop the economy of operating in district heating plants using domestic fuels. The study was carried out by gathering information from 15 district heating plants using different techniques and fuels. Efficiencies and emissions were measured in 10 plants. Besides determination methods for fuel energy were analyzed. In boiler measurements can be found that it has been possible to reach efficiencies which are more than 87% in all forms of combustion. The best efficiency was measured in fluidized bed boiler. In grate combustion boilers the best efficiencies were also better than 90%. The efficiencies of one boiler using combustion of gasified fuels were 2-3 percent units lower than in other boilers. This is caused by the evaporation heat at the moisten water needed in the combustion method. In most boilers the best efficiencies were reached burning fuel whose moisture was lower than that of the fuel meant to burn. Dust emissions in district heating plants firing domestic fuels were smaller than 300 mg/MJ on average, which is the maximum for older plants (effect 5-10 MW). For a while the dust content in flue gases increased for example by sweeping the boiler, by shaking up the electric precitator and by disturbances in fuel feeding. The emissions of peat burned in grate combustion or in fluidized bed were nitrogen oxides 90-290 mg/MJ and in combustion of gasified sod peat they were 185-515 mg/MJ. Conversion between nitrogen in fuel and nitrogen oxides in flue gases was in grate combustion and in fluidized bed combustion less than 10% and in combustion of gasified fuel 8-22%, when peat was burned. The charge of the fuel energy based on heat production gives by present knowledge as good and economical accuracy to determine fuel energy as methods based on fuel quality.

36678 (KTM/E-D—146) Electricity consumption of services. Koski, P. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jan 1988. 113p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753327/JAW.

In 1984 electricity consumption of services was over 7 TWh, which is about 15% of the total electricity consumption in Finland valued at FIM 2000 million. Community services (generation and distribution of heat and electric energy, water supply) and road lighting represent about 20% of the annual electricity consumption of services. The most important is the consumption of service and public buildings. Stores, hotels and restaurants represent about 40% of electricity consumption of service and public buildings. About half of that is consumed in department stores and food stores. This is the same amount as the consumption in office buildings. When examining electric load of services and changes of that it was found out that the load of office and school buildings was about 49% of the total load of service and public buildings on winter workday mornings. That is much more than the annual energy consumption share of those buildings, which is 35%. The load of stores, hotels and restaurants was on winter workday mornings 29% respectively - in the evening the load was about 42% corresponding to the annual energy consumption. Consumption of electric energy in services is growing fast - especially the consumption of service buildings. Only part of that is due to the growing volume of service buildings and spaces. Consumption of old buildings also often increases year by year and new buildings often use more electric energy than the old ones - school buildings are a good example. The growing and more versatile usage of electrical devices is probably one of the most significant factors which increases the electricity consumption in services.

36679 (PB—88-185087/XAB) Handbook: identification and correction of typical design deficiencies at municipal wastewater treatment facilities. (Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information). Apr 1982. 422p. (EPA—625/6-82/007). NTIS, PC A18/MF A01.

This handbook has been prepared for use by engineers involved in the design and review of designs for publicly-owned treatment works (POTWs). Its intent is to identify design deficiencies found to limit the performance of POTWs. Design considerations were developed that will eliminate these deficiencies during the design phases of the project. The document will prove useful to personnel involved in the operation and maintenance of POTWs since procedures are presented, where feasible, for correction of design deficiencies at existing facilities. Use of the handbook will assure that the design incorporates a maximum number of operational conveniences.

36680 (PB—88-197561/XAB) Resource recovery plant implementation: guides for municipal officials, planning and overview. Shilepsky, A.; Lowe, R.A. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 1976. 40p. (EPA—530/SW-533). NTIS, PC A03/MF A01.

Supersedes PB—259139.

This report replaces an earlier version entitled Resource Recovery Plant Implementation: Interim Report (SW-480) (PB-259139/4). The report will assist municipal offices in the planning and implementation of processing plants to recovery resources from mixed municipal solid waste. Contents include: Steps to resource recovery; Study (Resource recovery task force, Areas for study, Setting local goals, Outside planning/implementation assistance); Selection (Major decisions to be made, Technology - market, Financing, Operation, Procurement strategy); Procurement (Procuring a consulting engineer, Procuring a system contractor).

36681 (SAA—EMR11) Some administrative and jurisdictional aspects of district heating. (Smith, Auld and Associates Ltd. (Canada)). Dec 1976. 43p. (CE—01493). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study was undertaken to investigate and report on the institutional implications of introduction and operation of district heating systems in Canada. It focuses upon the relationship between the administrative and jurisdictional components at the local, regional, provincial and, where relevant, federal levels of government and would determine to what extent such administrative and jurisdictional relationships may or may not constitute barriers to the design, construction, operation, and maintenance of district heating systems. Three were chosen for examination. The first was an old system, in place for many years, in Winnipeg. The second represented a new district heating system being set up in Toronto. The third was a new system in the conceptual stage planned for the new town being created in North Pickering. The Winnipeg and Toronto systems use steam as the heating medium; in Pickering, consideration is being given to the use of hot water. The work program adopted included perusal of available literature, and discussions with public servants at all three levels of government and with representatives of consulting engineering and legal firms associated with the three district heating systems examined. The data so collected were consolidated and analyzed. Some of the administrative and jurisdictional problem areas associated with district heating, and some options which might be considered in alleviating such problems, are indicated. 11 refs.

36682 (SVF—272) Cooling of district heating water in existing consumer substations. Winberg, A.; Werner, S. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Aug 1987. 94p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753344/JAW.

The annual average cooling (in degrees Celsius) is estimated by using the ratio between the annual heat supplied and the annual amount of distribution water circulated through the substations. For the year 1985, these data have been gathered from 8591 substations in 7 Swedish district heating systems: Vaenersborg, Uddevalla, Boraas, Stenungsund, Moelndal, Goeteborg, and Stockholm. The annual average cooling has been estimated for each substation, and the estimations obtained have been correlated to consumer category (consumption pattern), date of connection to the district heating network (age), and the annual heat supplied (size). The analysis shows that neither consumption pattern, age, or size can explain the large differencies in annual average cooling among the various substations. Only a slight correlation to these three parameters was discovered. Dwelling and detached houses have about 20 per cent better cooling than other consumer categories, since the fraction of hot water supply in the heat load is high in these substations. The annual cooling is somewhat lower in older substations than in new ones. But many new substations have a lower temperature reduction than older ones. A similar weak correlation is present between cooling and size. Small substations have a cooling which is lower than the cooling for large substations. The lack of a strong correlation to consumption pattern, age, and size indicates that individual defects in the substations causes a bad temperature reduction of the distribution water. (authors).

36683 (SVF—286) Alarm systems - compatibility. Bodin, C.; Ljungqvist, J.; Rundstroem, T. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). Nov 1987. 69p. (In Swedish). (STUDSVIK-ED—87-5). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752991/JAW.

The following report gives the status on the technique to indicate moisture in the PUR-foam insulation of district heating networks. The report gives the technical status of the electronic systems for moisture detection of August 1986. The report also gives some views on strategies for thunderstorm protection and strategies to gain a certain degree of exchangeability. A laboratory test to investigate the influence on electrical resistance due to moisture penetrating into the insulation during construction of district heating network is presented. Results are discussed. A presentation is given concerning experiences made in the field, during 1985-86, regarding electrical resistance if water is leaking into the foam due to faulty welds on the service pipes. The report ends by giving some suggestions on drawing standards for electronic alarm system for leak detection. (authors).

36684 (VTT-PUBL—40) Mathematical model for strategy evaluation of municipal solid waste management systems. Kaila, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Sep 1987. 74p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753353/JAW.

A mathematical model for strategy evaluation of municipal solid waste management systems has been developed. The basic objective in model development has been to create a tool for practical strategy evaluation applications. The model is more comprehensive than earlier models in taking into account all the functional elements of a waste management system. Thus a wider range of technical alternatives and possible policy decisions and their effects can be analysed.

36685 The ORNL integrated forecasting system. Rizy, C.G. (Oak Ridge National Lab. (US)). pp 10.1-10.20 of Proceedings of the Maryland conference on electric utility load forecasting. Kahal, M.I. Annapolis, MD; Maryland Power Plant Siting Program (1983). (CONF-8306162—). Contract W-7405-ENG-26.

From Conference on electric utility load forecasting; Annapolis, MD, USA (8 Jun 1983).

This paper describes the integrated system for forecasting electric energy and load. In the system, service area models of electrical energy (kWh) and load distribution (minimum and maximum loads and load duration curve) are linked to a state-level model of electrical energy (kWh). Thus, the service area forecast are conditional upon the state-level forecasts. Such a linkage reduces considerably the data requirement for modeling service area electricity demand.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 36035, 36578, 36579

36686 (BCU/FC—021981) Producer, retailer and consumer perspectives on Canada's energy. Labelling program for major appliances. Claxton, J.D.; Anderson, C.D. (British Columbia Univ., Vancouver (Canada). Faculty of Commerce and Business Administration; Manitoba Univ., Winnipeg (Canada). Faculty of Administrative Studies). Feb 1981. 63p. (CE—01417). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In 1987 Canadian manufacturers began placing Energuide labels on refrigerators to comply with new regulations requiring energy consumption labelling on major appliances. An initial study, a field experiment, assessed the effect of energy labels on refrigerator purchasers. The recommendations put forward by the initial report dealt with future research and priorities for Energuide program management. This study addresses the recommendation to conduct diagnostic surveys using trained shoppers and consumer interviews in order to indicate the effectiveness of specific manage-

ment initiatives. Three major objectives were to interview manufacturers to assess impact in terms of product changes and energy related promotional emphasis, to interview retailers to assess impact in terms of products carried and energy emphasis by retail salespeople, and to interview consumers to assess impact on awareness, attitudes and behavior regarding appliance energy useage information. The supplementary paper that followed the initial report drew attention to the market segment where Energuide labels had had most impact. Consumers buying refrigerators in the 10 to 14 cubic foot range (where manual defrost was a viable option) were identified as most receptive to energy information. The current study reconfirms the significance of energy lables to this segment. Review of the study indicates that clear progress in label impact has been achieved. 1 fig., 10 tabs.

36687 (DOE/MI—0010-Vol.1) Project to design and develop an energy-related program: For public housing residents and renters: Volume 1, Final report. (Assignment Group, Rockville, MD (USA)). May 1988. 43p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010724/JAW.

This demonstration project was undertaken as a result of an unsolicited proposal submitted by THE ASSIGNMENT GROUP (TAG) to the Office of Minority Economic Impact, Department of Energy (DOE). The problem to which the proposal responded was how to minimize the costs associated with public housing tenants in standard public housing as well as under homeownership transfers. A related problem was how to graduate the tenants to another level of responsibility and self-sufficiency through resident business developments and training in energy-related fields. The size and gravity of the problem necessitated a purpose or aim that had nationwide application, yet lent itself to a microscopic look. Consequently, the goal that emanated was the design and development of an energy-related demonstration program that educates public housing residents, facilitates indigenous business development where appropriate, and trains residents to provide needed services.

36688 (DOE/MI—0010-Vol.2) Energy conservation practices participant manual: For public housing residents and renters. (Assignment Group, Rockville, MD (USA)). May 1988. 28p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010725/JAW.

This training manual focuses on actions which residents can take to improve energy conservation in their homes. (BCS)

36689 (MU/RG—101981) Communications effects and energy conservation. An annotated bibliography. Filiatrault, P. (Montreal Univ., Quebec (Canada). Centre de Recherche en Gestion). Oct 1981. 162p. (CE—01438). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The bibliographic work presented in this document provides a thorough review of information published in English on the state of the art in communication research as perceived in the discipline of marketing. The main objective of this research was to investigate existing knowledge on the measurement of communication effects. The domain of application was consumer energy conservation more specifically but it was expanded to include other various public and nonprofit sector applications. Two well-known models provide the theoretical background for the analysis of the publications considered in this bibliography. Types of effects, measurements, and research designs were also investigated. The definition of the categorization used concludes the section on methodology. Results are then presented. A preliminary classification with regards to interest is provided, followed by a classification according to content and research design. Finally, implications for public communications policies are drawn. 271 refs.

36690 (PNL—6572) Trends in household energy conservation attitudes and behaviors in the northwest: 1983-1987. Schultz, R. W.; Bailey, B. M. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 66p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011537/JAW.

The objective of this report is to present the results of a 1987 telephone survey on attitudes and behaviors toward energy conservation and to compare them with the results of similar surveys in 1983 and 1985. The surveys were conducted in the Bonneville Power Administration (BPA) service area: Washington, Oregon, Idaho and Western Montana. Data collected during the surveys were analyzed by Pacific Northwest Laboratory to assist the BPA in its energy conservation program planning, design, and marketing.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 36635

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 35698, 35699, 37247, 37252

36691 (AD-A—190697/3/XAB) Development of a laboratory test for multiport injector deposits: approaches 1 and 2. Final report. Stavinoha, L.L.; Estefan, R.M.; Marbach, H.W. (Southwest Research Inst., San Antonio, TX (USA)). Sep 1987. 56p. (SWRI—4765/1). NTIS, PC A04/MF A01.

This report evaluates a novel approach for measuring MPFI(Multiport Fuel Injectors) injector deposit-forming tendencies of fuel. By slowly coating a cylindrical metal surface with a thin film of gasoline and applying sufficient amounts of heat in alternate cycles of coating and soaking, two critical requirements of deposit formation were used. The deposit generated from a known injector-fouling fuel (fuel A) were measured gravimetrically and compared to a relatively clean fuel (fuel C). Significantly greater concentrations of deposits were measured from fuel A when compared to fuel C. Fuel A was treated with 2 different types of additives-polymeric and amine-from 4 different manufacturers at high, clean-up levels and low, keep-clean concentrations and evaluated by the Bomb Method. Very few deposits were measured by any of the additive-treated fuels at high or low treatment levels. Greatly reduced levels of each additive in fuel A were tested for additive response by measuring deposit formation of as a function of additive concentration. Several additives appeared to begin losing their efficacy at lower concentrations in fuel A. With an improved design of the delivery system and optimization of experimental parameters, the Bomb Method promises to be a viable bench test method for measuring the deposit-forming tendencies of fuel.

36692 (DOE/AL/16310—T2) Modelling of premixed combustion using a thin flame sheet and the effect of the hydrodynamic instability. Ghoniem, A.F.; Knio, O.M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). [1987]. Contract AC04-81AL16310. 54p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009467/JAW.

A dynamic thin flame model that introduces the effect of flame structure on the burning velocity is described and appropriate numerical schemes are constructed to obtain solutions in configurations with available experimental data for validation. Using this model, the role of the hydrodynamic instability, which arises due to the imbalance between the flow and the local burning velocities, on the evolution of the flame front and the pressure history during the combustion of premixed gases in confined chambers is investigated. It is shown that the hydrodynamic instability plays an important role and that accurate modeling can only be achieved if the stabilizing effect due to flame curvature is included, in the formulation. The problem is relevant to the modeling of combustion in engines, pressure rise due to confined explosion, and the analysis of processes governed by flame-flow interactions. Results provide an interpretation for phenomena associated with large scale distortion of flames and shed light on their underlying mechanism.

36693 (DOE/AL/38221—T3) Experimental validation of a zero-dimensional computer model for spark-ignition engines: Progress report. Scott, R.L. Jr. (Southern Univ., Baton Rouge, LA (USA). Dept. of Mechanical Engineering). 25 Apr 1988. Contract AS04-86AL38221. 30p. NTIS, PC A03;3. Order Number DE88009034/JAW.

This is a progress report on the subject contract. It contains a discussion of progress made to date on the engine design, and the computer code used for analysis. It also contains a statement on progress expected during the next reporting period.

36694 **(DOE/METC—87/0245) Coal-fueled heat engines: Technology status report.** (USDOE Morgantown Energy Technology Center, WV). Oct 1985. 99p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE87001026/JAW.

The Department of Energy, Office of Fossil Energy, through the Morgantown Energy Technology Center, is sponsoring activities to extend the technology base for coal-fueled heat engines. The heat engines of primary interest are the gas turbine and the diesel engine. The overall objective is the development of the technology base necessary for private-sector commercialization of complete and integrated heat engine systems that produce power from coal in an economically competitive and an environmentally sound manner. The objective will be attained through technical advances in four interactive program phases: feasibility validation, engineering development, advanced engineering development, and system integration. Efforts through FY 1985 have been concentrated in the feasibility validation and engineering development phases. These program phases are directed towards the identification of the most critical performance-limiting problems associated with the direct combustion of coal or minimally-cleaned, coal-derived gas in heat engines. Technology status and accomplishments in the areas of fuels technology, component development, contaminant control, and systems integration are presented in this report. 9 refs., 34 figs., 12 tabs.

36695 **(PB—88-181631/XAB) Operational Characteristics Study, Columbus, Ohio program. Technical report.** Thompson, G.; McCoy, R.; Hoekwater, M.; Snapp, L.; Schuler, A. (Environmental Protection Agency, Ann Arbor, MI (USA)). Aug 1987. 245p. (EPA/AA/SDSB—87/08). NTIS, PC A11/MF A01.

This report describes the Columbus, Ohio, program of the Operational Characteristics Study (OCS) which monitored the driving patterns of 47 private citizens in Columbus, Ohio, over a nine-month period from April 1983 to January 1984. These citizens were loaned one of four vehicles equipped with time, speed, distance, and temperature recording devices to gather a total of 251 days of in-use data. The report describes the details of the program, the results, and a comparison of the average-trip statistics to the Federal Test Procedure used in exhaust emissions testing for motor vehicles.

36696 **Nitric oxide emissions from a coal-fueled engine: Numerical results.** Caton, J.A.; Schmidt, J.; Roth, J.; Bachman, F. New York, NY; American Society of Mechanical Engineers (1988). 6p. (CONF-880104—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

Technical Paper 88-ICE-22.

A cycle simulation for coal-fueled, reciprocating, internal combustion engines has been expanded to include calculations of nitric oxide exhaust emissions. Calculations have been completed for a diesel oil and a coal-water slurry fuel. The fuels were assumed to be direct injected and compression ignited. The numerical simulation was based on a thermodynamic analysis with models for the injection, ignition, mixing, combustion, and heat transfer. The calculations of the nitric oxide formation and reduction reactions were based on the Zel'dovich mechanism. The engine performance parameters were in good agreement with published values in the literature. The computed exhaust nitric oxide concentrations for both the diesel and coal-water slurry fuels were in fair agreement with recent preliminary experimental values from the literature. In general, the exhaust nitric oxide concentrations were lower for the coal-water slurry fuel relative to the diesel fuel. The thermal nitric oxide production for the coal-water slurry fuel was a strong function of the coal/water mass ratio for the conditions examined. Also, rough estimates indicated that the nitric oxide from fuel-bound nitrogen could be significant for typical coal-water slurry fuels.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 36023, 36624, 37424

36697 **(CONF-880279—1) The outlook for ceramics in heat engines, 1990-2010: Results of a worldwide Delphi survey.** Larsen, R.P.; Vyas, A.D. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010075/JAW.

From Worldwide perspective on the status of ceramics for heat engines; Detroit, MI, USA (29 Feb 1988).

A study is described that was conducted to provide a realistic technical and economic assessment of the use of advanced ceramic materials technology for heat engines in transportation applications. Key results from a worldwide Delphi survey are presented on the expected timing and rate of market development for ceramic engine components and engines. These results show that, by the mid 1990s, a substantial number of ceramic engine components will be in production and ceramic-intensive engines will be introduced. Also presented in the study are benefits and barriers to the use of ceramic technology in heat engines and other relevant factors influencing its rate of adoption. A modeling approach is presented that uses the survey data to produce a series of market penetration curves for individual ceramic engine components for light- and heavy-duty applications under different scenarios. Finally, the conditions required for rapid market development of ceramic technology for heat engines are discussed.

36698 **(NEI-DK—55) Utilization of exhaust gases from a diesel engine for operating stirling engines.** Bak, F.; Monrad, K. (Jysk Teknologisk, Aarhus (Denmark)). Sep 1987. 121p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752831/JAW.

The Danish Ministry of Energy has financed this technical and economical investigation of waste heat recovery from diesel exhaust by means of a stirling engine. This report gives a description of the previously established optimal heat transfer. A computer program developed for calculation of the obtainable energy savings is described in detail. A financial evaluation proves the system to be unprofitable for ship economy as the price of the waste heat utilization system cannot compete with the present fuel oil prices (DKr 1.10 p. litr). The profit depends entirely on the oil market prices. (EG).

36699 **Reliability study of Stirling engines for solar-dish/heat engine systems.** Holtz, R.E.; Uherka, K.L. (Argonne National Lab., Argonne, IL (US)). pp 1885-1890 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879414.

The objective of this study was to examine the reliability of existing and improved Stirling engine concepts for dispersed solar-dish/electric applications in the 25-50 kWe range. Five current kinematic Stirling engine designs have the capability to meet or exceed the 32% system efficiency goal of the DOE Solar Thermal Program. Experience with the Vanguard Solar-Dish/Stirling Engine module demonstrated that the 32% efficiency goal is realistic, but that improved Stirling engine reliability is necessary for successful implementation of dispersed solar power systems. A review of historical Stirling engine data illustrated that the three major reliability issues with kinematic Stirling engines are the piston-rod seals, engine hot parts and power control/drive system. A specific kinematic engine concept that appears to have the potential for meeting the 50,000-hour operating lifetime requirement of solar power systems has a pressurized crankcase to reduce piston-rod seal problems, an indirectly heated hot-end section using heat pipes to smooth out temperature gradients in the heater tubes, and a variable-angle swashplate for power control. Further development efforts are required to establish reliability and validate performance goals of these engine concepts.

36700 **Fundamental flow and heat transfer results relevant to oscillating flow regenerators.** Hutchinson, R.A.; Ross, B.A. (Pacific Northwest Lab., Richland, WA (US)). pp 1859-1865 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879343.

Complete understanding of the operation of Stirling and other heat engine regenerators has evaded engineers working on engine development because making measurements in or near such a regenerator is difficult. Some illumination of the physics that may be involved, however, can be found by studying fundamental experimental results in the literature, results that were examined for other applications in addition to Stirling. Preliminary reviews of literature on the subjects of oscillating flows, periodic flows and porous media have brought to light interesting papers presenting a number of phenomena that may be of importance in heat engine regenerators. Some are also relevant to flows in other Stirling heat exchangers. These topics include heat tranfser during compression and expansion, enhanced conduction in oscillating laminar flows, approaches to analysis of nonuniform porous media, and heat transfer enhancement mechanisms in porous media. Each topic is briefly described and discussed in this paper, and a summary of physical phenomena that may affect regenerator performance is presented.

36701 **Mod II engine development.** Karl, D.W. (Mechanical Technology Inc., 968 Albany-Shaker Road, Latham, NY 12110 (US)). pp 1810-1816 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879158.

The Mod II engine is a four-cylinder, automotive Stirling engine utilizing the Siemens-Rinia double-acting concept. It has a single crankshaft and the cylinders are arranged in a 'vee' configuration with two cylinders in each bank. It is the culmination of nine years of design, development, and testing efforts that began in 1978. The primary objective of the program is to demonstrate, by early 1988, a Stirling-engine-powered automobile with 30% greater fuel economy than its counterpart, the gasoline-fueled, internal-combustion engine. The Mod II engine was assembled and became operational in January 1986. It was operated in a dynamometer test cell using facility-supplied auxiliaries and controls. The complete engine system is scheduled to start testing in June 1987, and its installation into the vehicle should be accomplished by late 1987. This paper describes the Mod II engine, its first assembly, and the subsequent work done on engine components up to the point that engine performance characterization testing took place. Performance data for the engine is included.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 36634

36702 **(DOE/CE—0213) Electric and Hybrid Vehicles Program: 11th annual report to Congress for fiscal year 1987.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Transportation Systems). Mar 1988. 42p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010339/JAW.

This eleventh annual report on the implementation of the Electric and Hybrid Vehicle Research, Development and Demonstration Act of 1976 (Public Law 94-413, as amended by Public Law 95-238, and Public Law 96-185), referred to as the Act, complies with the reporting requirements established in Section 14 of the Act. In addition to informing Congress of the progress and plans of the Department of Energy's Electric and Hybrid Vechicles Program, this report is intended to serve as a communication link between the Department and all of the public and private interests involved in making the program a success. During FY 1987, significant progress was made toward fulfilling the intent of the Congress in the Act. There has been continuing interest shown by both the automobile manufacturing and supply sectors of our economy in electric and hybrid vehicles. The three major domestic automobile manufacturers are all devoting some effort towards electric vehicles. Their participation includes cost-shared contracts with the Department of Energy and the Electric Power Research Institute as well as independently funded activities. Research and development efforts in batteries and propulsion components continue to achieve significant progress in providing industry with technology options that will result in vehicles that will be more economically competitive and more acceptable to the public.

36703 **(PB—88-863501/XAB) Electric vehicles. January 1970-May 1988 (Citations from the US Patent data base). Report for January 1970-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 94p. NTIS PC N01/MF N01.

Supersedes PB—87-860615.

This bibliography contains citations of selected patents concerning design techniques of electric vehicles for road and rail transportation. Drive and control systems for electric vehicle operation are discussed. Battery recharge, replacement, and monitoring methods and systems are presented. Solar energy, wind power, and manual devices used in charging batteries are considered. (This updated bibliography contains 204 citations, 24 of which are new entries to the previous edition.)

36704 **(SAND—88-1421C) Sodium/sulfur cell evaluation results.** Freese, J.M.; Butler, P.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 19p. (CONF-8806127—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011488/JAW.

From 7. DOE/EPRI beta battery workshop; Toronto, Canada (1 Jun 1988).

Sandia National Laboratories has been evaluating the performance of various sodium/sulfur cells since 1985. The objectives of these evaluations were to characterize the performance of these cells, determine their longevity, identify performance or life limiting design problems, and conduct post-test analyses to determine the cause of failure. These results were communicated to each developer with recommendations for design improvements or other suggestions to resolve problem areas.

3306 Vehicle Design Factors

36705 **Advanced chemical laser cavity fuel injection system.** Morr, G.F.; Pruett, S.L. (to Secretary of the Army, Washington, DC). US Patent 4,737,965. 12 Apr 1988. Filed date 2 Jan 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a chemical laser cavity fuel injection system, a converging-diverging nozzle for accelerating an oxidizer at a supersonic Mach number. The converging-diverging nozzle has opposite diverging walls that terminate at an exit plane of the converging-diverging nozzle. A boundary layer region is adjacent each diverging wall, a pair of manifolds are mounted relative to the converging-diverging nozzle structure and at the exit plane of the converging-diverging nozzle where the diverging walls terminate. Each of the pair of manifolds has fuel injection wedges connected thereto with fuel ports, thereein for injecting fuel therethrough. The wedges of each of the pair of the manifolds project in opposite directions and across a portion of the converging-diverging nozzle exit plane from one diverging wall toward the other and each of the wedges terminate at one of the boundary layer regions to define a multiplicity of wedges that are mounted on the pair of manifolds in a staggered arrangement so that each wedge is fed fuel from one end and terminated at another end before projecting across the one of the boundary layer regions to cause pressures and Mach numbers from flow through the nozzle and at spaced positions across the nozzle to be more uniform due to the wedges being staggered and terminating at the one of the boundary layer regions to thereby reduce pressure losses through the nozzle and cause a more efficient lasing medium to be produced.

3307 Emission Control

REFER ALSO TO CITATION(S) 36631, 36631, 36695, 36696, 37404, 37675

36706 (PB—88-195219/XAB) Motor vehicles as sources of compounds important to tropospheric and stratospheric ozone. Black, F.M. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Apr 1988. 30p. (EPA—600/D-88/067). NTIS, PC A03/MF A01.

One of the most-rapidly growing human activities in the U.S. of importance to atmospheric ozone is the use of highway motor vehicles. Transportation sources are estimated to have been responsible for about 34% of 1985 U.S. anthropogenic hydrocarbon emissions, 70% of carbon monoxide emissions, 45% of nitrogen oxide emissions, 24% of nonaerosol chlorofluorocarbon emissions, and 14% of carbon dioxide emissions. Data are presented describing possible uninventoried transportation hydrocarbon emissions that could increase their estimated contribution to 45 - 50% of the anthropogenic total. Data is also presented suggesting motor vehicles to be relatively insignificant sources of anthropogenic nitrous oxide, but noting that these emissions are increased by the control technologies used to reduce hydrocarbon, carbon monoxide, and nitrogen oxides emissions. The sensitivity of motor-vehicle emission rates and compositions to such operating variables as ambient temperature, altitude, and average speed is discussed.

36707 (VTT-TUTK—496) Automotive exhaust emissions at low ambient temperature. Laurikko, J.; Nylund, N.-O.; Sipilae, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752876/JAW.

Cold ambient conditions have a distinct impact on the total emission of the Finnish car park because climatic conditions in Finland are rather severe regarding the use of automobiles. In the present study, the exhaust emission characteristics of three automotive petrol engines with different fuel metering systems were evaluated. Experiments were carried out on an engine and exhaust system combination in cold chamber at a constant ambient temperature ranging from +20 deg C to -30 deg C. Test procedures included either constant or variable load mode during a 30 minute run. The test results show that the use of the enrichment devices necessary during cold-start and warm-up period has a major impact on the total emissions during the test. In the carburetted non-catalyst engines the share of the initial emissions during cold-start and warm-up phase was smaller than with the fuel-injected catalyst version. The catalytic converter equipped version was also found to be far more sensitive to the low ambient temperature than the normal carburetted versions without exhaust aftertreatment. The relative increase in CO and HC emissions when the ambient temperature was lowered was in case of the fuel-injected catalyst engine some 5 to 15 times greater than with the normal carburetted version of the same engine. Although the temperature of the converter rose quite quickly after the cold start it did not promote the conversion, because the enrichment circuit of the fuel injection system overriched the air-fuel mixture, thus optimising the driveability, but making the operation of the three-way catalytic converter impossible. The carburetted test engines were found to be quite sensitive to intake air temperature.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 35926

36708 (CONF-880180—2) The past and future of the petroleum problem: The increasing need to develop alternative transportation fuels. Santini, D.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 37p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010089/JAW.

From 67. annual transportation research board meeting; Washington, DC, USA (11 Jan 1988).

An examination of the interactions of petroleum supply and demand patterns suggests that the depletion of US oil reserves and the increasing importance of oil consumtion in US transportation are causes for greateer attention to the development of alternative (non-oil based) transportation fuels. Absent such development, the historical lessons in this paper suggest that another period of rising oil prices, erratic oil market behavior, and subsequent economic difficulty is probable within the next two decades. Methanol is argued to be the most likely and most desirable substitute transportation fuel, because it can be produced more econmically and used more efficently than gasoline derived from the rapidly expanding worldwide supplies of natural gas.

36709 (GAO/RCED—88-38BR) Alternative fuels: Information on DOE's Methanol Vehicle Demonstration Program. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 16p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy established a methanol vehicle demonstration program to encourage the fuel's increased use by stimulating the commercial readiness of methanol-fueled vehicles. This report discusses why other federal agencies have not participated in the program, DOE's experience in acquiring and operating demonstration fleets, coordination between the DOE and Department of Defense programs, and a recent initiative to acquire flexible-fueled vehicles that can operate on gasoline, methanol, or a combination of both fuels.

36710 (PB—88-188909/XAB) Gas-engine durability improvement - topical report. Final report for Phase 1 information gathering. Report for October 1985-June 1986. Treuhaft, M.B.; Klusmeyer, L.F.; Brown, R.D.; Hull, R.W. (Southwest Research Inst., San Antonio, TX (USA). Dept. of Engine and Vehicle Research). Jun 1986. 92p. NTIS, PC A05/MF A01.

The need to improve the durability of natural gas-fueled engines by eliminating or reducing exhaust valve and valve-seat failures is being addressed. The report covers the information and data gathering phase. A literature search was conducted to investigate the historical treatment of valve and valve-seat wear and to determine the state-of-the-art with respect to the design and use of exhaust valves and seats. Visits were made to natural gas-fueled engine users, maintenance shops, engine manufacturers, and valve and valve-seat-insert manufacturers. Valve and valve-seat problems were found to be a maintenance concern. Manufacturers reported that valve and seat-insert materials requirements for gas engines are more stringent than for gasoline or diesel engines. The type of engine oil used is thought to have a strong influence on valve/seat durability; low-ash or no-ash oils are preferred. Phase II will evaluate different valve and seat materials as well as various formulations of lubricants.

36711 (VTT-TIED—771) Suitability of fuel blends containing 30-60% methanol to Finland's conditions. Eklund, T. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1987. 43p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752995/JAW.

The aim was to study with the aid of laboratory tests and a one-car field experiment, how high a methanol content can be used in methanol-gasoline fuels in Finland's conditions without any appreciable changes in cars, such as installation of cold-start systems. The fuels studied were so-called MX fuels with 30-60% methanol content. In the laboratory tests, phase separation was studied by adding water to the fuel. The higher the methanol content, the better the water tolerance of the fuel was. There is no greater risk of separation in careful fuel handling, when using the fuels studied. Material tolerance was studied both by soaking parts of the fuel system and by monitoring the condition of the field test car. The soaked parts, specially certain metal ones, corroded significantly. Cold-start experiments were done both on a test engine in a cold research room and with the car as a field experiment. The methanol content of the MX fuels should be 30-40%, with regard to differences in the properties of various engines, to quarantee a sufficient cold-start reliability. In the field experiment, the driveability of the car was the most significant factor. It was satisfactory during the winter as well. Only the nozzle of the carburettor had to be changed and the preheating of intake air improved. The results of

exhaust gas experiments and fuel consumption were equal or superior to those obtained with gasoline.

36712 **(VTT-TIED—772) Ethanol as a fuel of a lorry. Use experience from a diesel engine modified to an otto engine.** Nylund, N.-O.; Eklund, T. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1987. 66p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752870/JAW.

When using alcohol for the fuel of a diesele, either the engin engine or the fuel must be converted due to the poor ignition of alcohols. A direct injection diesel engine is usually easy to convert into an otto engine. The otto version is technically simple, although its efficiency is lower than that of a diesel engine. The limit values of performance and the driveability characteristics of a simple otto engine version were determined in the test. This otto engine version could be of significance in a crisis provided that alcohol fuels are available. There is also a rising interest in alcohol-fueled spark-ignition versions in developing countries. A Finnish-made Valmet 611 turbo diesel engine was chosen for conversion. No special parts were used in this work. The engine was first driven in an engine dynamometer. The maximum power of the free-respiration ethanol version was about 85% of that of a turbo diesel and the peak thermal efficiency was 34%. For the evaluation of driveability, the converted engine was installed in a Karhu-Sisu lorry. The lorry was driven about 8500 km with E90 fuel. The performance values of the lorry were on average 15% lower for the ethanol-fueled engine than for the original diesel. The average fuel consumption was 52 l/100 km during the test, corresponding to aboaut 30 l/100 km for a diesel engine. Hence, the energy consumption was about 20% higher than that of a diesel engine. The tests indicated that it is relatively easy to convert a diesel engine to a spark-ignition one and to achieve a satisfactory level of performance. The performance and availability of the alcohol engine is by far superior to a producer (wood) gas engine.

36713 **Concentric layer ramjet fuel.** Burdette, G.W.; Francis, J.P. (to Secretary of the Navy, Washington, DC). US Patent 4,729,317. 8 Mar 1988. Filed date 8 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a solid fuel ramjet grain comprising concentric layers of solid ramjet fuel having a perforation therethrough along the center axis of the grain. The perforation is connected to a combustion after-chamber. The solid ramjet fuel layers comprises a pure hydroxyl-terminated polybutadiene hydrocarbon fuel or a mixture of a hydroxyl-terminated polybutadiene hydrocarbon fuel and from about 5 to about 60 percent by weight of an additive to increase the fuel regression rate selected from the group consisting of magnesium, boron carbide, aluminum, and zirconium such that, when buried in the operation of the ramjet, each fuel layer produces a different level of thrust.

35 ARMS CONTROL

REFER ALSO TO CITATION(S) 37373

3501 Policy, Negotiations, And Legislation

36714 **(LA—11262-MS) Los Alamos strategic defense research and the ABM (Anti-Ballistic Missile) Treaty.** Morales, R.; Pendley, R.E. (Los Alamos National Lab., NM (USA). Center for National Security Studies). Apr 1988. Contract W-7405-ENG-36. 32p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011505/JAW.

This report reviews the restrictions placed on Los Alamos strategic defense by current arms control treaty agreements, including controversies about the correct interpretation of the major treaty at issue, the Anti-Ballistic Missile Treaty; and it assesses the current status of the most significant Los Alamos strategic defense programs in terms of their compliance with that Treaty, and others. 7 tabs.

3502 Proliferation

36715 **(AD-A—190476/2/XAB) Measures and trends, US and USSR strategic force effectiveness. Sanitized. Final report, May 1977-July 1978.** Paolucci, D.A.; Wikner, N.F.; Trapold, A.C. (Santa Fe Corp., Alexandria, VA (USA)). Jul 1978. 271p. NTIS, PC A12/MF A01.

Sanitized version of report dated July 1978, AD-C016 317; Availability: Document partially illegible.

This report is a compilation and description of the measures of effectiveness that have been used in the analysis and comparison of US and USSR strategic nuclear forces and weapons systems. The primary purpose of the report is to provide an understanding of the measures of effectiveness that can be used in an analysis of the strategic balance. Although a knowledgeable strategic analyst may consider some of the discussions elementary, the manner of presentation was selected to make the report useful to a wide range of readers. Historical trend plots of thirteen general measures of effectiveness and relevant subsets of these measures of effectiveness are presented. For each measure, a description that identifies the limitations and uncertainties associated with the particular measure is provided: The thirteen basic measures considered are: Strategic Nuclear Delivery Vehicles; Independently Targetable Warheads; ICBM Throw-Weight; SLBM Maximum Range; Gross Yield; Equivalent Megatons; Lethal Area Potential; Weapon System Delivery Accuracy; Hard Target Kill Capability; Counter Military Potential; Surviving ICBM Launchers; Retaliatory Equivalent Weapons; Strategic Defensive Systems.

3503 Verification

REFER ALSO TO CITATION(S) 37634

36 MATERIALS

REFER ALSO TO CITATION(S) 37357, 38514

36716 **(AERE-R—12964) Analysis of irradiated materials.** Bellamy, B.A. (ed.). (UKAEA Harwell Lab. Materials Development Div.). Jan 1988. 23p. (CONF-8711196—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753507/JAW.

From UKAEA conference on materials analysis by physical techniques; Windscale, UK (17 Nov 1987).

Papers presented at the UKAEA Conference on Materials Analysis by Physical Techniques (1987) covered a wide range of techniques as applied to the analysis of irradiated materials. These varied from reactor component materials, materials associated with the Authority's radwaste disposal programme, fission products and products associated with the decommissioning of nuclear reactors. An invited paper giving a very comprehensive review of Laser Ablation Microprobe Mass Spectroscopy (LAMMS) was included in the programme.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 35557, 35711, 35714, 35715, 35820, 35835, 35872, 35872, 35903, 36101, 36144, 36151, 36158, 36190, 36200, 36200, 36200, 36207, 36218, 36226, 36226, 36265, 36265, 36303, 36304, 36308, 36309, 36331, 36345, 36345, 36364, 36439, 36439, 36862, 36888, 37030, 37208, 37281, 37305, 37356, 37381, 38879

36717 **(AD-A—190407/7/XAB) Investigation and synthesis of high-temperature and increased-stiffness RSP aluminum alloys. Annual report, 1 October 1986-30 September 1987.** Fine, M.E.; Weertman, J.R. (Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering). Sep 1987. 21p. NTIS, PC A03/MF A01.

The objective of this research is to investigate two promising systems as the basis for high-temperature aluminum alloys useful to 425 C (800 F). The first is a metal-matrix composite consisting of an aluminum-magnesium alloy matrix reinforced by spinel (magnesium aluminate) particulate. The second system is tri aluminum (zir-

conium, vanadium) dispersed in aluminum matrix; here the lattice parameter matches that of the matrix. Research on dilute alloys has shown a low coarsening rate for this intermetallic at 425 C. Study of more-concentrated alloys is underway. A mechanical alloying liquid-metal infiltration procedure for preparing specimens of the aluminum alloy matrix spinel composite was worked out and specimens with 4 vol% spinel were prepared. Also, 4 vol.% alumina composite samples were prepared for comparison. Spinel particles were within the aluminum alloys grains in contrast to the alumina which was at grain boundaries. The spinel composite had much better creep resistance at 410 C. Extrusions containing 5 vol.% trialuminum (0.75 vanadium, 0.25 zirconium) were prepared for this research by Lockheed-Palo Alto from rapidly solidified foil. The measured creep rate at 425 C is much lower than in the current aluminum-iron-cerium alloy. An aluminum-vanadium intermetallic compound, however, forms at grain boundaries leading to a precipitate-free zone which grows slowly at 425 C.

36718 (AD-A—190510/8/XAB) Growth of corner cracks under the conjoint action of high- and low-cycle fatigue. Final report, June 1985-June 1987. Powell, B.E.; Henderson, I.; Hall, R.F. (Portsmouth Polytechnic (UK). Mechanical Behaviour of Materials Lab.). Feb 1988. 98p. NTIS, PC A05/MF A01.

Fatigue-crack propagation rates were measured for Ti-6A1-4V and Ti-5331S aeroengine disc materials using compact tension and corner-notched tensile test-pieces. The loadings used simulate both the start-stop operations of aeroengines which lead to low-cycle fatigue and the in-flight vibrations which may cause high-cycle fatigue. It is suggested that the different fatigue crack-growth behavior of Ti-5331S, relative to that of Ti-6A1-4V, arises largely from the greater proportion of crack closure and short crack growth occurring in this alloy.

36719 (AD-A—190537/1/XAB) Theory of liquid-phase sintering: model experiments on W-Ni-Fe heavy alloy system. Farooq, S.; Bose, A.; German, R.M. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 1987. 14p. NTIS, PC A03/MF A01.

Pub. in Progress in Powder Metallurgy, Vol. 43, 65-77(1987).

Current liquid-phase sintering theories predict negligible densification prior to the formation of a liquid phase. While these theories are fully applicable to a few model systems, their validity is questionable under more general circumstances. Experiments on a 93% W-Ni-Fe heavy alloy show that nearly 94% of the total shrinkage occurs prior to liquid formation. In this study, densification behavior has been studied by means of constant heating rate dilatometry. The microstructural evolution during sintering was monitored by quantitative microscopic examination of samples quenched from various temperatures during heating. The actual amount of densification that occurs prior to liquid formation is observed to be a function of both material process parameters. It was found that the contribution of solid-state-enhanced sintering to densification increases with slower heating rates. Thus, the role of rearrangement in densification during liquid-phase sintering is of less importance in common commercial systems (like W-Ni-Fe), where the additive phase exhibits solubility for the major phase. Rearrangement becomes important only at faster heating rates, especially in low solubility systems. This paper demonstrates that the mechanisms proposed by current theories are inadequate to explain densification behavior during liquid-phase sintering. Finally, an alternative approach to understanding liquid-phase sintering is suggested; and the new theory is outlined.

36720 (AERE-R—12855) Thermal conductivity of oxide layers formed on the water side of a fast reactor evaporator tube. Silver, P.; Gilchrist, K. (UKAEA Northern Research Labs., Springfields). (UKAEA Harwell Lab. Chemistry Div.). Apr 1988. 13p. H.M. Stationery Office, London, price Pound 4.00.

Samples of a sodium heated heat exchanger tube with over 24,000 hours service at 310°C were obtained and their thermal diffusivities measured over the temperature range 290 -700°C. The effective thermal conductivity of the oxide layer was calculated from the results. It is proposed that the value obtained, 2.61 +- 0.45 $Wm^{-1}\,°C^{-1}$, can be used in calculations of the heat transfer in boilers.

36721 (ANL/FE—88-1) A review of solid particle erosion of engineering materials. Majumdar, S.; Natesan, K.; Sarajedini, A. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 105p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88009363/JAW.

A detailed modeling effort was initiated to develop an analytical capability to predict corrosion/erosion behavior of structural materials in advanced fossil technologies. As part of this program, a literature search was conducted to collect the available erosion data on materials of interest in fossil energy technology and to evaluate the capability of the existing erosion models to correlate the data. Although a signficant literature on the review of erosion model already exists, most of these studies concentrate primarily on erosion of pure metals or simple alloys, for which these models were specifically developed. The purpose of the present study is to evaluate the ability of the currently available erosion models to correlate the erosion data on technologically important alloys. The materials of interest are broadly divided into four categories: low alloy steel, high alloy steel, nickel-based superalloy, and cobalt-based superalloy. 44 refs., 84 figs., 2 tabs.

36722 (BFR-R—109-1986) Problems due to precipitation of iron in groundwater-based heatpump systems. Lindblad-Paasse, A. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 143p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752905/JAW.

This report deals with the problems due to precipitation of iron in groundwater-based heatpump systems. Fifteen installations have been examined, water and precipitate samples have been taken, microorganisms have been investigated and problems in running the installations have been studied. Proposals have been put forward for both preventive measures to stop precipitation of iron in the systems, and remedial measures to remove existing deposits. The ability of different materials to adsorb iron has been investigated in the laboratory.

36723 (BNL—41211) Anomalous rf magnetoresistance in copper at 4{degree}K. Halama, H.J.; Prodell, A.G.; Rogers, J.T.; De Panfilis, S.; Melissinos, A.C.; Moskowitz, B.E.; Semertzidis, Y.K.; Wuensch, W.U.; Fowler, W.B.; Nezrick, F.A. (Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 16p. NTIS, PC A03. Order Number DE88010232/JAW.

We have measured the effect of a magnetic field on the surface resistance of polycrystalline Cu at f = 1.2 GHz and at 4.4{degree}K; under these conditions the surface resistance is well into the anomalous skin effect regime but has not reached its limiting value. We find that the transverse and longitudinal magnetoresistance are an order of magnitude smaller than the DC magnetoresistance and depend quadratically on the field. At low fields we observe a decrease in surface resistance with increasing field which can be interpreted as a size effect of the TF surface current. 17 refs., 4 figs., 1 tab.

36724 (CEA—000G108) Uses and evaluation methods of potential hydrogen permeation barriers for nuclear reactor materials. Noga, J.O.; Piercy, G.R.; Bowker, J.T. (Canadian Electrical Association, Montreal, Quebec). Jul 1985. 141p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702225/JAW.

This report summarizes results on the use of coatings as hydrogen permeation barriers on nuclear reactor component materials. Two classes of base materials were considered, exothermic hydrogen absorbers and endothermic hydrogen absorbers. The results of the tests indicate that substantial reductions in the amount of hydrogen absorbed by a metal can be achieved through the use of hydrogen permeation barrier coatings. Gold was determined to provide an effective hydrogen permeation barrier on Zr-2-1/2 Nb pressure tube material. Tin was determined to be a suitable hydrogen permeation barrier when applied on AISI 410 stainless steel and iron. Both gas phase and electrochemical permeation techniques were

used to determine hydrogen permeabilities through coatings and base materials.

36725 (CEA-CONF—9230) Fatigue analysis - computation of the actual strain range using elastic calculations (factor K/sub e/). Roche, R.L. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 24p. (CONF-8709279—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753454/JAW.

From 6. international conference on pressure vessel technology (ICPVT 6); Beijing, China (11 Sep 1987).

Pressure vessels are not eternal, their life is not endless, but must be long enough for profitable use. Fatigue is the most important damage limiting life time. It is due to variable loading and especially to deformation-controlled loading like thermal dilatation (thermal stress). Hence, it is of prime importance to perform an fatigue analysis in the design phase in order to be sure the pressure vessel life meet requirement of the design specification. It is also useful to perform such an analysis for assessing the remaining life. To compute the fatigue damage, knowledge of the strain range is needed. As calculation taking into account non linear behavior of the material are very expensive and not always reliable, the current practice is using elastic computation. The aim of this paper is to discuss the methods for correcting the elastically calculated strain range and to propose a sound and practical method.

36726 (CEA-CONF—9235) Simplified elastoplastic fatigue analysis. Autrusson, B.; Acker, D.; Hoffmann, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 19p. (CONF-8708255—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753457/JAW.

From 2. international seminar on construction codes and engineering mechanics; Lausanne, Switzerland (24 Aug 1987).

Oligocyclic fatigue behaviour is a function of the local strain range. The design codes ASME section III, RCC-M, Code Case N47, RCC-MR, and the Guide issued by PNC propose simplified methods to evaluate the local strain range. After having briefly described these simplified methods, we tested them by comparing the results of experimental strains with those predicted by these rules. The experiments conducted for this study involved perforated plates under tensile stress, notched or reinforced beams under four-point bending stress, grooved specimens under tensile-compressive stress, and embedded grooved beams under bending stress. They display a relative conservatism depending on each case. The evaluation of the strains of rather inaccurate and sometimes lacks conservatism. So far, the proposal is to use the finite element codes with a simple model. The isotropic model with the cyclic consolidation curve offers a good representation of the real equivalent strain. There is obviously no question of representing the cycles and the entire loading history, but merely of calculating the maximum variation in elastoplastic equivalent deformations with a constant-rate loading. The results presented testify to the good prediction of the strains with this model. The maximum equivalent strain will be employed to evaluate fatigue damage.

36727 (CEA-CONF—9237) Modelizing ratcheting in biaxial tests. Guionnet, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 23p. (CONF-870850—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753459/JAW.

From Seminar on extreme load design of future nuclear plant facilities; Paris, France (24 Aug 1987).

A new constitutive equation has been developed on a purely phenomenological basis in order to interpret ratcheting experiments. The model is based on a generalized Arsmstrong-Frederick equation for the kinematic variable; the coefficients of this equation are functions of both instantaneous and accumulated plastic strain. The experiments described relate to austenitic stainless steel (17-12 SPH) tubular specimens subjected to cyclic torsional loading under constant tensile stress at 600 deg C. Comparisons between experimental and theoretical results show that the model reasonably well predicts not only ratcheting but also hysteresis loops and the cyclic hardening curve.

36728 (CEA-R—5415) Effect of heat and mechanical treatments on the microstructure of type Z6 CNDT 17.13 phosphorus containing, titanium stabilized austenitic stainless steels. Gandit, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France)). Jun 1987. 67p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753476/JAW.

The heterogeneities in composition resulting from hot transformation are eliminated by high temperature heat treatments. Phosphorus additions to this type of stainless steel does not affect significantly the homogeneity in composition. A significant lowering of the recrystallisaton temperature results from cold working. In addition, the precipitation of minute titanium-crystals is promoted as well as that of phosphorus at temperatures between 500 and 600oC. At concentrations in excess of 0.1 %, phosphorus precipitation induces a significant change in the crystal lattice. At high concentrations, phosphorus precipitates upon show heating or cooling (rate below 100 deg C/min) requiring a high temperature heat treatment to revert to solution (above 1000 deg C). This type of steel is chosen for fuel cans of LMFBR reactors.

36729 (CNEA-NT—6/86) Boron autoradiography method applied to the study of steels. Gugelmeier, R.; Barcelo, G.N.; Boado, J.H.; Fernandez, C. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). 1986. 17p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702228/JAW.

The boron state, contained in the steel microestructure, is determined. The autoradiography by neutrons is used, permiting to obtain boron distribution images by means of additional information which is difficult to acquire by other methods. The application of the method is described, based on the neutronic irradiation of a polished steel sample, over which a celulose nitrate sheet or other appropriate material is fixed to constitute the detector. The particles generated by the neutron-boron interaction affect the detector sheet, which is subsequently revealed with a chemical treatment and can be observed at the optical microscope. In the case of materials used for the construction of nuclear reactors, special attention must be given to the presence of boron, since owing to the exceptionaly high capacity of neutron absorption, lowest quantities of boron acquire importance. The adaption of the method to metallurgical problems allows the obtainment of a correlation between the boron distribution images and the material's microstructure. (M.E.L.).

36730 (CONF-880318—2) Novel magnetic materials research using free electron lasers. Bader, S.D. (Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009989/JAW.

From Topical meeting on free-electron laser applications in the ultraviolet; Cloudcroft, NM, USA (2 Mar 1988).

Synchrotron-radiation sources have dramatically increased the research capabilities of materials scientists. In the following, broad examples of magnetic materials research opportunities are considered. Order-of-magnitude estimates are then given of source flux and spin-polarized signal level for an undulator and an FEL source. The comparison illustrates the impact expected of FEL sources on magnetic materials research in the future. 10 refs.

36731 (CONF-880432—1) Brillouin scattering: its application to the study of damage and amorphization. Grimsditch, M.; Bhadra, R.; Gray, K.; Kampwirth, R.T.; Okamoto, P.; Pearson, J.; Rehn, L. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31-109-ENG-38. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012053/JAW.

From 8. general conference of the Condensed Matter Division, European Physical Society; Budapest, Hungary (6 Apr 1988).

A brief review of Brillouin scattering is made emphasizing its advantages and disadvantages over conventional ultrasonic techniques. One of its advantages is that the elastic properties of very thin films (~ 1μ) can be investigated. The authors have used this technique to study changes in shear elastic constants of materials irradiated with high energy ions. These particles only penetrate ~ 1μ into the material but produce very high defect concentrations which, in certain cases, can lead to amorphization. In Nb_3Ir and Zr_3Al very large changes are observed before the onset of amorphization, while in Si the changes occur concomitantly with amorphization. The significance of the hardening observed in Zr_3Al when it becomes amorphous will be discussed.

36732 (CONF-880606—3) Thermal conductivity and thermal expansion of stainless steels D9 and HT9. Leibowitz, L.; Blomquist, R.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011973/JAW.

From 10. symposium on thermophysical properties; Gaithersburg, MD, USA (20 Jun 1988).

Renewed interest in the use of metallic fuels in liquid-metal fast breeder reactors has prompted study of the thermodynamic and transport properties of its materials. Two stainless steels are of particular interest because of their good performance under irradiation. These are D9, an austenitic steel, and HT9, a ferritic steel. Thermal conductivity and thermal expansion data for these alloys are of particular interest in assessing in-reactor behavior. Because literature data were inadequate, measurements of these two properties for the two steels were performed and are reported to 1200 K. Of particular interest is the influence on these properties of a phase transition in HT9.

36733 (CONF-880613—9) Modeling studies on the precipitation of Kr after implantation into metals. Rest, J. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 25p. (CONF-880613—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009987/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

A rate-theory approach is applied to interpreting observations on the precipitation of Kr injected into Ni at temperatures between 25 and 560{degree}C. At temperatures of 400{degree}C or higher, the implanted Kr precipitates evolve into a bi-modal size distribution containing small solid precipitates and an additional population of larger, faceted bubbles. The calculations explore the dependence of the observed bi-modal distribution on the maximum size of the solid Kr precipitates and the effect of this dependence on bubble mobility. The analysis suggests that during the irradiation, whereas the large bubbles move by surface diffusion, the solid Kr precipitates are immobile. The relevance of the Kr-Ni interaction on the solid Kr precipitates size cutoff is discussed. 18 refs., 8 figs., 2 tabs.

36734 (CONF-880613—10) An HVEM study of displacement cascade damage in Nb_3Sn at 13 K. Kirk, M.A.; Baker, M.C.; Kestel, B.J.; Weber, H.W.; Kampwirth, R.T. (Argonne National Lab., IL (USA); Wisconsin Univ., Madison (USA); Atominstitut der Oesterreichischen Universitaeten, Vienna). Feb 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009997/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

TEM images of the martensite structure in Nb_3Sn were recorded at various temperatures between 12 and 30{degree}K. The transition to the superconducting state was observed by a slight deflection of the electron beam due to a perturbation of the magnetic field of the objective lens at the sample. The primary interest is in irradiation effects due to fast neutrons from a fusion reactor, and therefore ion irradiation conditions that are somewhat comparable to this were selected. These consisted of 50 keV Xe/sup {plus/} irradiations to simulate neutron produced cascades in a near surface region and 1.5 Mev Kr/sup {plus/} to produce cascade damage through a greater sample thickness. Defect images were obtained as a function of ion dose at 13{degree}K using both fundamental and superlattice dark-field reflections in two-beam conditions. For 50 keV Xe/sup {plus/} irradiations at 13{degree}K the defect yields were quite low at low ion doses where individual defect cascades are well separated. At higher ion doses when significant cascade overlap is present, defect density and contrast became greater than expected. Annealing to room temperature produced a large increase in defect density. Irradiation by 1.5 MeV Kr/sup {plus/} at 15{degree}K removed the martensite structure by an ion dose of 5{times}10^{12}cm/sup {minus/2}. Further irradiation to 3.5{times}10^{13}cm /sup {minus/2} produced evidence for the initial stage of amorphization 24 refs., 3 figs.

36735 (CONF-880613—12) The influence of other microstructural features on void formation and void growth in irradiated materials. Stoller, R.E.; Mansur, L.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 46p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010456/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

The chemical rate theory of radiation effects has been used previously to establish that the presence of either residual or transmutant gases is necessary to obtain the void concentrations that are observed in many irradiated materials. In the present work, the rate theory has been used to compare the significance of several microstructure-dependent mechanisms that can influence void formation and growth. Some mechanisms reduce the time required for a gas-stabilized bubble to reach the critical size by either increasing the gas accumulation rate or by reducing the critical number of gas atoms required for void formation. Void growth can be increased by mechanisms that lead to more efficient partitioning of vacancies to the voids. Several of these mechanisms involve the presence of precipitates. The influence of the total precipitate sink strength on the evolution of matrix cavities has also been examined. Other mechanisms included in this comparison are helium collection at network dislocations and solute trapping. Results indicate that a {open+-quotes}favorable{close+-quotes} microstructure can lead to large reductions in the void formation time and increases in the void growth rate. The influence of precipitates is consistent with the experimental observation that the largest voids in irradiated alloys are frequently associated with these particles. Helium and point defect collection are shown to be the most significant precipitate effects. 33 refs., 12 figs.

36736 (CONF-880613—13) Swelling suppression in phosphorous-modified Fe-Cr-Ni alloys during neutron irradiation. Lee, E.H.; Packan, N.H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011010/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

Phosphorous-containing austenitic alloys in the solution annealed condition were irradiated at 745--760{degree}K. The alloys were variations on Fe--13Cr--15Ni--0.05P with respective additions of 0.8 Si, 0.2 Ti, or 0.8 Si {plus} 0.2 Ti; also included were low (0.01) and zero P compositions (all values in wt. %). The reference ternary and the two phosphorous-only variations contained little precipitation and numerous voids and swelled rapidly, while the three variants containing P with Si and/or Ti showed little or no void formation and profuse phosphide precipitation. Results indicate that phosphorous in solution alone does not have a major influence on void swelling, whereas fine-scale phosphide precipitation is quite effective at eliminating void formation. The principal mechanism restricting swelling is the effect of the dense precipitate microstructure. These precipitates foster profuse cavity nucleation which in turn dilutes the helium atoms (and more time) in order for individual cavities to surpass their critical size and number of gas atoms necessary for subsequent growth as voids. This mechanism for swelling suppression was not found to be particularly sensitive to moderate variations in either the dislocation or cavity densities; the mechanism is strongest at elevated temperature where the critical quantities are large and is less effective at lower temperatures where the critical quantities are small. 19 refs., 10 figs., 3 tabs.

36737 (CONF-880661—8) A review of solid particle erosion of engineering materials. Majumdar, S.; Sarajedini, A. (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 30p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010065/JAW.

From ASME pressure vessel and piping conference; Pittsburgh, PA, USA (19 Jun 1988).

A detailed modelling effort is currently under way to develop an analytical capability to predict corrosion/erosion behavior of structural materials in advanced fossil technologies. As part of this program, a literature search was conducted to collect the available erosion data on materials of interest in fossil technology and to evaluate the capability of the existing erosion models to correlate the data. Although a significant literature on the review of erosion models already exists, most of these studies concentrate primarily on erosion of pure metals or simple alloys, for which these models were specifically developed. The purpose of the present study is to evaluate the ability of the currently available erosion models to correlate the erosion data on technologically important alloys. The materials of interest are broadly divided into four categories: low alloy steel, high alloy steel, nickel-based superalloy, and cobalt-based superalloy. As expected, the extent of erosion data on the engineering materials is rather limited, particularly at the temperatures of interest. In general, the available data are correlated poorly by the existing models. The poor correlation is mainly due to the variability of the erodent size and hardness, which are not generally accounted for in the models. To a limited extent, the variability of the data also reflects the fact that different alloys are grouped into a single class. The correlation is improved significantly if data are restricted to a limited temperature range and to erodents of similar hardness and of size larger than a critical size. 24 refs., 11 figs., 1 tab.

36738 (CONF-880704—1) Magnetic fluctuations and heavy electron superconductivity. Norman, M.R. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011978/JAW.

From 6. international conference on crystal field effects and heavy fermion physics; Frankfurt, F.R. Germany (18 Jul 1988).

A magnetic fluctuation self-energy based on neutron scattering data is used to calculate mass renormalizations, and superconducting critical temperatures and order parameters, for various heavy electron metals.

36739 (CONF-880705—1) Magnetic excitations in transition metal systems. Cooke, J.F.; Blackman, J.A. (Oak Ridge National Lab., TN (USA); Reading Univ. (UK). Dept. of Physics). May 1988. Contract AC05-84OR21400. 11p. (CONF-880705—). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011022/JAW.

From International conference on magnetism; Paris, France (25 Jul 1988).

An expression for the neutron scattering cross section based on itinerant electron theory within RPA has been derived which incorporates the most general form of the exchange matrix consistent with crystal symmetry. Numerical results indicate a wider range of spin-wave behavior than found previously.

36740 (CONF-880705—2) Inelastic electron scattering and electron-hole excitations in iron and nickel. Blackman, J.A.; Cooke, J.F. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011843/JAW.

From International conference on magnetism; Paris, France (25 Jul 1988).

Spin-flip and non-spin-flip mechanisms have been proposed to explain polarization asymmetry in inelastic electron scattering from iron and nickel. A maximum in the asymmetry near 2eV in iron can occur by both mechanisms. The 300meV maximum in nickel is unlikely to occur by non-spin-flip transitions.

36741 (CONF-880724—14) Design of a controlled temperature flue gas corrosion probe. McEvers, J.A.; Federer, J.I. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007480/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

The need to determine suitable materials for use in industrial waste heat recovery systems requires assessment of materials degradation in various flue gas environments. Such an assessment generally involves exposing candidate materials to the environments, then analyzing the effects of the exposure conditions. Degradation of materials is related to flue gas chemical composition, temperature, and thermal cycling behavior. Temperature variations, especially atypical thermal cycling, complicate the task of characterizing such phenomena as corrosion rates and corrosion mechanisms. A relatively constant temperature would allow a more accurate determination of the effects of flue gas chemical composition and temperature. In response to this need, a flue gas corrosion probe has been designed for exposure tests of materials. The probe allows materials to be tested at nominally constant temperatures within a wide span of either constant or changing flue gas temperatures. This paper describes the design and fabrication of the corrosion probe system. 9 refs., 4 figs., 6 tabs.

36742 (CONF-8704190—3) Influence of the interface on the crystallization of amorphous Ge in Pb/Ge multilayers. Sevenhans, W.; Locquet, J.P.; Bruynseraede, Y.; Homma, H.; Schuller, I.K. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010072/JAW.

From 7. general conference of the Condensed Matter Division of the European Physical Society; Pisa, Italy (7 Apr 1987).

The amorphous to crystalline phase transition of Ge in contact with Pb has been extensively investigated in Pb/Ge multilayers. We find that the Ge crystallizes at reduced temperatures in the range of 100-200{degree}C depending on the thickness of the Ge and the Pb. Simultaneously the texture of the Pb improves and the layered structure completely disappears. The basis for the reduction of the crystallization temperature is the enhanced diffusion kinetics at the interface, caused by the adjacent Pb layer. 20 refs., 4 figs.

36743 (CONF-8706295—1) Irradiation creep and embrittlement behavior of AISI 316 stainless steel at very high neutron fluences. Porter, D.L.; Garner, F.A. (Argonne National Lab., IL (USA); Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract W-31109-ENG-38. 19p. (CONF-8706295—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009949/JAW.

From International workshop on mechanisms of irradiation creep at very high neutron fluences; Hecla Island, Canada (15 Jun 1987).

The irradiation-induced creep and swelling of AISI 316 stainless steel have been investigated at two temperatures (400 and 550{degree}C) to very high neutron fluences. It is shown that creep and swelling can be considered as interactive phenomena with several stages of creep related to the total amount of accumulated swelling. The final stage involves the apparent cessation of creep and has been observed only at the higher irradiation temperature. The development of a coincident and severe ex-reactor embrittlement problem after irradiation at 400{degree}C appears also to be separately related to the development of substantial swelling. This latter phenomenon was not observed at 550{degree}C. The mechanisms thought to be possibly responsible for each of these two phenomena are discussed in detail. 29 refs., 9 figs.

36744 (CONF-8803104—1) Electronic structure of Zintl phase compounds by nonlinear optimization. Woodward, C.; Benedek, R.; Min, B.I. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009998/JAW.

From Sanibel symposium on atomic, molecular and condensed matter theory; Gainesville, FL, USA (12 Mar 1988).

Since the introduction of dynamical simulated annealing (DSA) by Car and Parrinello in 1985, there has been growing interest in the use of nonlinear optimization to perform electronic structure calculations. We review here the complementary method of steepest descents (SD), a first-order treatment designed for local

optimization. Modifications are discussed to adapt SD to a supercell treatment of metallic systems using a plane wave basis. An application to the Zintl phase compound NaTl is presented. The application of separable nonlocal pseudopotentials to improve this momentum space formalism is discussed. 18 refs., 1 fig.

36745 **(CONF-8803114—1) Electrodeposition of cadmium from aqueous fluoroborate electrolytes.** Varma, R.; Shimotake, H.; Hoeller, T.L.; Agarwala, V. (Argonne National Lab., IL (USA); Amoco Research Center, Naperville, IL (USA); Wisconsin Univ., Madison (USA). Materials Science Center). 1988. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012042/JAW.

From Corrosion '88; Houston, TX, USA (21 Mar 1988).

A new method of electroplating cadmium on high-strength steel from aqueous fluoroborate electrolytes has been developed at Argonne National Laboratory. The cadmium coatings are fine grained, coherent, and strongly adherent to the substrate. With this method, a high-rate electrodeposition is achieved in an electrolyte-flow cell using an optimized pulse-nucleation step followed by deposit growth under a DC or pulsed current. This method results in minimal hydrogen codeposition during plating, which can lead to steel embrittlement.

36746 **(CONF-8804112—2) A new model for the simulation of interfaces at high temperature.** Lutsko, J.F.; Nguyen, T.; Phillpot, S.R.; Wolf, D.; Yip, S. (Argonne National Lab., IL (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Apr 1988. Contract W-31-109-ENG-38. 5p. (CONF-8804112—). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009926/JAW.

From Interfacial structure, properties and designs in solids; Reno, NV, USA (5 Apr 1988).

A new method for the molecular dynamics simulation of bulk planar interfaces at high temperatures is presented. The method uses the basic Parrinallo-Rahman (constant stress) scheme modified, however, for the application to inhomogeneous systems. Since our computational cell contains only one interface with 2-d periodic boundary conditions we are able to study isolated interfaces all the way up to melting. The interaction between boundaries which may lead to their annihilation at higher temperatures, which is a problem when 3-d periodic boundaries are applied, is thus avoided. As an application, the method is used to study the stability of a grain boundary at high temperatures. Observations on a possible connection between grain boundary migration and "premelting" are discussed. 5 refs., 15 figs.

36747 **(CONF-8804112—5) Controlling phase formation and stability to improve the high temperature creep resistance of austenitic stainless steels.** Maziasz, P.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011401/JAW.

From Interfacial structure, properties and designs in solids; Reno, NV, USA (5 Apr 1988).

New Fe-14Cr-16Ni-2.5Mo-2Mn steels modified with carefully controlled additions of Ti, Nb, V, C, P and B have been developed which have outstanding creep rupture resistance at 700{degree}C and 170 MPa, much better than comparable commercial steels. The minor alloying element levels and combinations were chosen a priori to produce specific microstructures of fine MC and FeTiP precipitates in the matrix and coarser carbides ($M_{23}C_6$, M_6C and MC) along grain boundaries before creep properties were ever measured. The precipitates directly produce the creep resistance observed in the new steels. The ideas that guided these modifications to tailor and control the precipitate microstructure stem from years of studying precipitation in aged and reactor irradiated steels by the use of analytical electron microscopy (AEM). 14 refs., 5 figs., 1 tab.

36748 **(CONF-8804124—1) Fluid flow modeling in casting processes and its implications.** Sha, W.T. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010009/JAW.

From Modeling control of casting and welding processes conference; Palm Coast, FL, USA (17 Apr 1988).

In recent years, mathematical modeling of casting processes has received increasing attention; however, very little work has been done on modeling of fluid flow of liquid melt. This paper discusses some important aspects and implications of fluid flow modeling pertinent to casting processes. The recent advances and projected progress of computer technology and numerical analysis have made is possible to begin to perform realistic simulations of the casting process in general and to model fluid flow of liquid melt in particular. Topics to be discussed include the (1) desirability of a computer system specifically for casting modeling, (2) need for efficient solution technique for fluid flow and user-friendly pre- and post-processors or user-interface package, and (3) development of both realistic constitutive relations and reliable material properties pertinent to castings. Fluid flow of liquid melt plays an important role in the design of the feed system and mold, solidification rate and pattern, gas entrainment, and segragation of alloy elements. 29 refs., 2 figs.

36749 **(CONF-8805134—2) Use of Moessbauer spectroscopy to study implanted surfaces.** McHargue, C.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010452/JAW.

From Ion implantation and plasma assisted processes for industrial applications conference; Atlanta, GA, USA (21 May 1988).

The technique of Moessbauer spectroscopy in which the conversion electrons emitted during the decay of an excited nucleus are measured in the backscattered geometry is particularly useful for the study of ion implanted materials. The technique is nondestructive and probes a depth comparable to the ion range for most implantation conditions. The hyperfine structure of the Moessbauer spectra gives three important parameters: the isomer shift, the quadrupole splitting, and the magnetic hyperfine splitting. The analysis of these parameters provides information on the electronic structure and local symmetry of the implanted ion. Examples will be given for the use of conversion electron Moessbauer spectroscopy (CEMS) to study implanted metals and ceramics. 14 refs., 6 figs.

36750 **(CONF-8805141—1) Evaluation of fracture models through pressurized-thermal-shock testing.** Pugh, C.E.; Bryan, R.H.; Bass, B.R.; Nanstad, R.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011834/JAW.

From IAEA specialists' meeting on fracture mechanics verification by large-scale testing; Stuttgart, F.R. Germany (25 May 1988).

Two multiple-transient pressurized-thermal-shock experiments (PTSEs) have been conducted under the NRC-sponsored Heavy-Section Steel Technology (HSST) program. The first test (PTSE-1) employed an SA-508 class 2 steel with high Charpy upper-shelf energy level and a relatively high brittle-to-ductile transition temperature. The second test (PTSE-2) used a 2 1/4 Cr-1 Mo steel (SA-387 grade 22) that had been given a special heat treatment to yield a low Charpy upper-shelf energy level and attendant low tearing resistance. Each experiment included two combined thermal and pressure transients that give rise to propagation and arrest of an initial long flaw that extended about 10% through the thick wall of the test cylinder. Both materials exhibited the ability to inhibit crack propagation by warm prestressing, high initiation toughness values and high crack-arrest toughness values. Cleavage initiation and arrest are modeled well by available fracture theories. However, calculations of ductile tearing based on resistance curves did not consistently predict the observed tearing.

36751 **(DOE/ER/02390—T2) Basic research in crystalline and noncrystalline ceramic systems: Annual report for the period December 1, 1983 to November 30, 1984.** (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1984. Contract AC02-76ER02390. 318p. NTIS, PC A14;3. Order Number DE88011578/JAW.

The basic research program in crystalline and noncrystalline ceramic systems sponsored by the US Department of Energy sup-

ports a significant fraction of the research effort and graduate student training in ceramics at MIT. During the past year kinetic and equilibrium studies related to grain boundary segregation and grain boundary properties in a variety of materials including structural ceramics such as silicon carbide and aluminum oxide have been completed. Another significant area of study has been related to sintering behavior and grain growth in structural and other ceramics. Included in this report are the following: electrical and optical properties, grain boundary mobility, sintering, diffusion, defects, quenching of solid samples for high temperature equilibrium measurement, and suppression of insulator charging during SIMS and SEMS measurements. 227 refs., 113 figs., 23 tabs.

36752 **(DOE/ER/45138—T2) Corrosion fatigue of small cracks: Mechanics and chemistry: Final technical progress report, July 1, 1984-October 31, 1987.** Wei, R.P. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Mechanical Engineering and Mechanics). 7 Mar 1988. Contract FG02-84ER45138. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007955/JAW.

The principal contributions of this study have been briefly summarized. Firstly, electrochemical reaction control of corrosion fatigue crack growth in ferrous alloys was demonstrated. The controlling reactions are those involving equilibration of the crack-tip bare surfaces with its neighboring filmed or oxidized surfaces. Secondly, the electrolyte within the crack serves as a high resistance path that separates the crack tip region from the bulk (external) environment. Because of this high resistance, the crack tip region is effectively shielded and the reactions are affected little by the externally imposed conditions, with the crack-tip potential tending to remain very near the free corrosion potential. Thirdly, with increases in test temperature, it becomes increasingly difficult to displace the crack-tip potential away from the free corrosion potential. In other words, because of the increased reaction rate at higher temperatures, larger currents must be imposed to maintain the surface at a prescribed potential. The increased currents, however, result in greater potential drop along the crack, and thereby reduces the change in potential at the crack tip under a fixed applied potential. The details of electrochemical conditions and of the mechanisms of reactions, however, are much more complex, and would require further study. Fourthly, the results provide further support for hydrogen embrittlement as the mechanism for crack growth enhancement for the austenitic stainless and the carbon strengthened steels. Lastly, the role of grain boundaries in influencing short-crack growth response has be elucidated.

36753 **(DOE/ER/45154—T3) Nucleation and growth of solid-state transformations: Progress report, August 1, 1987{endash}July 31, 1988.** Olson, G.B.; Parks, D.M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1988. Contract FG02-84ER45154. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009887/JAW.

Research is being done on transformation plasticity in steels. A model for the kinetics of strain-induced transformation of dispersed austenite, using data for the martensitic transformation of iron particles precipitated in a copper matrix, has been developed. Also completed was a study of strain-induced transformation kinetics, transformation plasticity and toughening in phosphocarbide-strenghtened austenitic steels. A model for strain induced transformation in finite element calculations has been implemented. (CBS)

36754 **(DOE/ER/45211—4) Grain boundary structure in Ni_3Al.** Mackenzie, R.A.D.; Vaudin, M.D.; Sass, S.L. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Jul 1987. Contract FG02-85ER45211. 7p. (CONF-870793—7; MSC—6186). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009164/JAW.

From Conference on interface science and engineering; Lake Placid, NY, USA (12 Jul 1987).

The influence of boron segregation and non-stochiometry on grain boundary structure in Ni_3Al was studied by transmission and scanning electron microscopy techniques. Small angle twist and tilt boundaries were produced by hot pressing misoriented single crystals of both doped and undoped materials. Dislocation structures were observed in both bicrystal and polycrystal grain boundaries. In most cases the grain boundary dislocations were found to have the expected a<100> Burgers vector, however, in one case dislocations with Burgers vector a2<110> dislocations have been observed. Using a SEM diffraction technique the frequency of occurrence of grain boundary types was examined and found to be unchanged by the addition of boron. 12 refs., 4 figs.

36755 **(DOE/ER/45211—6) The influence of solute segregation on the dislocation structure of small and large angle [001] twist boundaries in Fe-Sb alloys.** Lin, C.H.; Sass, S.L. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Feb 1988. Contract FG02-85ER45211. 7p. (MSC—6357). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009166/JAW.

The dislocation structure of small and large angle [001] twist boundaries in Fe{endash}Sb alloys is influenced by the segregation of Sb to the vicinity of the interface. Since changes in the dislocation structure of [001] twist boundaries due to solute segregation have now been observed in the Fe{endash}Au and Fe{endash}Sb systems, this behavior is believed to represent a generally occurring phenomenon in Fe alloys. 18 refs., 3 figs.

36756 **(DOE/ER/45211—8) High resolution detection of solute segregation to the cores of dislocations in grain boundaries.** Michael, J.R.; Lin, C.H.; Sass, S.L. (Bethlehem Steel Corp., PA (USA). Homer Research Lab.; Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Mar 1988. Contract FG02-85ER45211. 5p. (MSC—6391). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009168/JAW.

Thin film Fe–0.8 at. % Au bicrystals, {approximately}60 nm thick, containing [001] twist boundaries were prepared. The average compositon of the bicrystal was determined by Rutherford backscattering spectroscopy (RBS), which also showed that the Au was nonuniformly distributed along the direction normal to the interface, with a large amount concentrated at the [001] twist boundary. This observation constitutes direct evidence that the Au is segregated to the vicinity of the grain boundary. The Au distribution within the plane of the interface was analyzed in a Vacuum Generators HB-501 scanning transmission electron microscope (STEM) equipped with a field emission electron source and a Link Analytical windowless x-ray detector. The boundary plane was oriented perpendicular to the electron beam. Digital line scans were performed across the dislocation network. Au segregates extensively to the cores of the <100>-type dislocations in small angle [001] twist boundaries in Fe–Au alloys. Our observations demonstrate that the <110> network is favored in pure Fe, which leads to the suggestion that the dislocation core energy plays an important role in determining the stable boundary structure.

36757 **(DOE/ER/45211—9) Grain boundary characterization in Ni_3Al.** Mackenzie, R.A.D.; Vaudin, M.D.; Sass, S.L. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Mar 1988. Contract FG02-85ER45211. 7p. (CONF-8804112—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009169/JAW.

From Interfacial structure, properties and designs in solids; Reno, NV, USA (5 Apr 1988).

Grain boundaries in both pure and boron doped Ni_3Al have been studied using a variety of electron microscopy techniques. Small angle boundary structures were examined in both bicrystal and polycrystalline specimens. Dislocaions with Burgers vector a2<110> are observed in the presence of boron, while dislocations with Burger vector a<100> are observed in the absence of boron. A possible explanation for this behavior is the presence of a disordered layer at the interface in boron-doped Ni_3Al. The addition of boron to Ni_3Al was seen to induce faceting of grain boundaries, and to afford the boundaries some protection from etching. Using electron backscatter diffraction patterns, the frequency of occurrence of grain boundary types was found to be unchanged by the addition of boron.

36758 (DOE/ER/45213—3) Microchemical analysis of polycrystalline Ni_3Al and other ordered alloys using the field-ion microscope atom probe: Technical progress report. Brenner, S.S. (Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering). 31 May 1988. Contract FG02-85ER45213. 15p. NTIS, PC A03;3. Order Number DE88011519/JAW.

We have used the field-ion microscope atom probe to detect chemical changes that occur at the grain-boundaries of nickel aluminide as a result of the boron additions. We have also examined the matrix of boron-doped hyperstoichiometric nickel aluminide to determine whether boron clustering could be responsible for the lack of response of these alloys to boron ductillization. Finally, we have measured the site occupation probability of hafnium and tantalum in nickel aluminide using the atom probe's atomic layer-by-layer analysis capability. The site occupation results are useful in understanding the solid solution strengthening effect in nickel aluminide. The results of our expermental program are briefly described. 17 refs., 5 figs., 1 tab.

36759 (DOE/ER/45214—T1) Twin boundaries and heterophase interfaces in ferroelastic martensites. Annual progress report No. 3, January 16, 1986-June 30, 1988. Barsch, G.R. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.). 1988. Contract FG02-85ER45214. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011894/JAW.

A comprehensive theoretical study with concurrent supporting experimental investigations is being carried out on coherent and semicoherent interfaces in ferroelastic martensites, including twin boundaries and twin bands, heterophase parent/product interfaces and inclusions, and transformation precursors. This work is motivated by the need for a new theoretical basis for investigating the martensite nucleation mechanism and for establishing the conditions for nonclassical nucleation. Soliton-like solutions of a dynamic Ginzburg-Landau continuum theory for ferroelastic martensites are being studied in order to determine the strain distribution, strain energy and dynamical behavior for various geometric configurations as a function of the material parameters, temperature and boundary conditions. Model parameters of the theory consist of the second and higher order elastic constants and the harmonic strain gradient coefficients in the parent phase. X-ray measurements of the transformation strain versus temperature, and simultaneous ultrasonic velocity and attenuation measurements on biaxially stressed crystals in In/sub 1-x/Tl/sub x/ alloys for determining the second and higher order elastic constants in the single domain tetragonal state and for studying the morphology and the dynamic behavior of the martensite interfaces and transformation precursors have been started or are in preparation, respectively.

36760 (DOE/ER/45281—2) Investigation of magnetic anisotropy and spin wave modes in transition metal multilayers: Technical progress report, August 1987 through July 1988. Pechan, M.J. (Miami Univ., Oxford, OH (USA)). 1988. Contract FG02-86ER45281. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009007/JAW.

The magnetic properties of compositionally modulated structures known as superlattices or multilayers are of considerable interest because of their application to magnetic recording technology and because of the insight provided into the fundamental nature of magnetism. Anisotropic properties are of vital import in developing stable, well defined, high density magnetic domains in both flux and optically detected magnetic recording media. Spin wave investigations on the other hand, provide insight into the fundamental nature of surface spin states and interior spin dynamics. Measurements on CuNi and MoNi indicate a very large degree of magnetic anisotropy, which seems to be frequency dependent. The sources of the anisotropy have not been fully explained and the reason for the frequency dependence remains unknown. The FMR measurements on these systems all show definite structure in the perpendicular spectra, but spin wave analysis of this structure has not been reported. It is reasonable to assume that the source of the anisotropy, its frequency dependence and the perpendicular FMR structure are intimately related. Work is being continued on high T/sub c/ oxide superconductors.

36761 (DOE/ER/45310—8) Grain boundaries: Annual technical progress report. Balluffi, R.W.; Bristowe, P.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 28 Apr 1988. Contract FG02-87ER45310. 10p. NTIS, PC A02;3. Order Number DE88009889/JAW.

The present document is a progress report describing the work accomplished on the study of grain of gold. The research that was proposed initially for this period consisted of studies of the atomistics structure of grain boundaries by means of combined x-ray diffraction and computer modeling and of grain boundary phase transitions by electron microscopy and computer modeling. Progress has been made on both of these areas which is described in more detail. A list of reports describing the research completely during the first year is presented.

36762 (DOE/ER/45311—T1) The structure and properties of grain boundaries in B2 ordered alloys. Baker, I. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 4 Apr 1988. Contract FG02-87ER45311. 14p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009890/JAW.

During this period we have produced fine-grained alloys of FeAl and NiAl which span the respective phase fields of these materials. We have: (1) initiated mechanical testing of the FeAl alloys as a function of grain size, which confirms that the yield strength decreases with increasing deviation from stoichiometry; (2) initiated grain growth studies of the FeAl alloys, whose preliminary results suggest that grain growth is more rapid in off-stoichiometric compositions; (3) successfully prepared thin foils of NiAl alloys and iron-rich FeAl alloys for transmission electron microscopy; (4) initiated an Atom Probe Field Ion Microscope study of the grain boundary chemistry of NiAl; (5) attempted to study boundary chemistry in NiAl and studied grain boundary chemistry in Ni_3Al using Auger electron spectroscopy; and (6) performed a short oxidation study of FeAl, which shows that oxidation rate increases with increasing iron content in FeAl. 3 refs., 2 figs., 3 tabs.

36763 (DOE/NASA/16310—6) Characterization of precipitates in a niobium-zirconium-carbon alloy. Grobstein, T. L.; Titran, R. H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. Contract AI03-86SF16310. 15p. (CONF-861076—9; NASA-TM—100848; CONF-861076—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011534/JAW.

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

A niobium alloy with 1 percent zirconium and 0.063 percent carbon by weight was investigated in the as-rolled and annealed conditions, and after high-temperature (1350 and 1400 K) exposure with and without an applied stress. In the as-rolled and in the annealed conditions, large metastable carbides were observed in addition to a regular distribution of small particles. During the high-temperature exposure, the majority of the large carbides were dissolved and a more stable carbide phase formed. This finely dispersed phase had a composition determined to be {approximately}70 percent ZrC and {approximately}30 percent NbC and showed some evidence of an orientation relationship with the matrix. The precipitates appeared to coarsen slightly after {approximately}5000 hr exposure at temperatures between 1350 and 1400 K. This same high-temperature exposure in the presence of an applied stress resulted in a decrease in the size and in the interparticle spacing of the stable precipitates. However, the composition of the precipitate phase and its ability to pin dislocations were not affected by the temperature or stress conditions.

36764 (EPRI-CS—5695) On-line corrosion monitoring in cathodically protected systems: Final report. McKubre, M.C.H. (SRI International, Menlo Park, CA (USA)). May 1988. 324p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011531/JAW.

This report describes the development of a novel method for the determination of corrosion parameters and for calculating corrosion rates in cathodically protected systems. This method, called harmonic impedance spectroscopy, employs a medium amplitude si-

nusoidal current or voltage perturbation sufficient to drive the current/voltage response of the corroding electrode into nonlinearity.

36765 (ETSU-WN—5085-P1) Cumulative damage of welded joints: a literature survey of the influence of stress magnitude on the value of Σ{sub(N)}{sup(n)}. Final report. Gurney, T.R. (Welding Inst., Cambridge (UK); UKAEA Harwell Lab. Energy Technology Div.). Jul 1987. 64p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ. Order Number TI88102090/JAW.

The great majority of structures and components which are at risk from fatigue failure, including wind turbines, are subjected to stresses of variable amplitude. On the other hand, most fatigue test results have been obtained under conditions of constant amplitude loading, and it is those results which have been used to derive fatigue design rules for welded joints. Thus, in order to design a structure for variable amplitude loading, use is normally made of Miner's linear damage rule. However, the evidence suggests that Miner's rule may be unsafe if the loading involves relatively frequent applications of the peak stress. It was also found that the values of Σsub(N)sup(n) (where n is the number of stress cycles and N the corresponding number of cycles to failure) appeared to be dependent upon the magnitudes of the applied stresses. On the basis of that finding that it was proposed that this survey should be carried out, with the object of determining whether or not the finding could be confirmed. The results of the survey are given.

36766 (ETSU-WN—5085-P2) Summary of constant amplitude fatigue test data for welded joints at long endurances. Final report. Gurney, T.R. (Welding Inst., Cambridge (UK); UKAEA Harwell Lab. Energy Technology Div.). Jul 1987. 41p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ. Order Number TI88102091/JAW.

Existing fatigue design rules are not necessarily safe for the welded joints of wind turbine generators where very long endurances in the region of 10^8 - 10^9 cycles can be expected. Fatigue test data for welded joints at long endurances have been compiled, therefore, with a view to determining the fatigue limits more accurately. The results of the survey are presented.

36767 (ETSU-WN—5085-P3) Influence of a salt spray environment on the fatigue strength of welded joints (literature survey). Final report. Gurney, T.G. (Welding Inst., Cambridge (UK); UKAEA Harwell Lab. Energy Technology Div.). Sep 1987. 18p. British Lending Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ. Order Number TI88102092/JAW.

Wind turbine generators are likely to be sited either offshore or in coastal locations and will be subjected therefore to intermittent salt water spray. In the event of the breakdown of corrosion protection coatings on critical parts of the structure, such as the welded steel blades, the fatigue strength may be reduced. In view of the fact that existing design standards and guidelines do not address this situation, data has been compiled on the influence of salt spray (or similar) on the fatigue strength of welded joints in structural steels and is summarized in this report.

36768 (FRCEA-TH—56) Study of interaction of fatigue damage and ratcheting. Effect of a tensile primary load on torsion fatigue resistance of stainless steel 304 L at ambient temperature. Hakem, N.S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Paris-6 Univ., 75 (France)). 29 Sep 1987. 228p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88752578/JAW.

Effect of ratcheting on fatigue resistance of a stainless steel 304 L, used for reactor vessels, is studied experimentally. Lifetime of samples is reduced if a static constant tensile load (primary loading) is superimposed to cyclic torsion deformations (secondary loading). An equivalent deformation concept is developed to express a criterion of fatigue rupture under primary loading. No effect is noted on the curve of cyclic strain hardening. This fatigue analysis gives no information on cumulated axial deformation. Progressive elongation, observed during testing, is dependent of primary and secondary loading. Rupture is produced by fatigue because cumulated axial deformation is limited (<4%) and lifetime is independent of cumulated axial deformation. Results show that for more than 10/sub 4/ cycles at rupture cumulated deformation is <0.5% and below 5000 cycles deformation is ≧ 1%. Two domains are evidenced: one where ruin is obtained by fatigue and in the other one by ratcheting. In this last domain cumulated deformation is higher than 0.5%, 1% value admitted by ASME codes. 103 refs.

36769 (GKSS—87/E/30) Determination of elastic-plastic fracture toughness parameters, with particular regard to the activities of the EGF. Schwalbe, K.H.; Neale, B.K.; Ingham, T. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). 1987. 27p. (In German). (CONF-8703268—). GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.).

From 19. meeting of the Technical committee on Fractures of Deutscher Verband fuer materialpruefung e.V.: fracture mechanics of welded joints; Freiburg im Breisgau, F.R. Germany (16 Mar 1987).

The progress made in the field of non-linear fracture mechanical testing, and the experience gained so far with existing testing methods and standards have induced the European Group on Fracture (EGF), to establish a Task Group for screening and compiling the European knowledge and experience for setting up a standard procedure for non-linear fracture mechanics testing. The work accomplished so far by the Task Group is explained against the background of existing methods.

36770 (INIS-BR—969) Kinetic of martensitic transformations induced by hydrogen in the austenite. Oliveira, Sergio P. de; Saavedra, A.; Miranda, P.E.V. de. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1986. 19p. (In Portuguese). (CONF-8610317—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701623/JAW.

From 4. Brazilian symposium on piping and pressure vessels; Salvador, BA, Brazil (28 Oct 1986).

The X-ray diffractometry technique was used, with an automatic data acquisition system to determine the kinetics of hydrogen induced martensitic phase transformations in an AISI 304 austenitic stainless steel type, used in nuclear power plants. Hydrogenation was performed cathodically in a 1N sulfuric acid solution, containing 100 mgl of arsenic trioxide, at 50°C, during 2 hours and with a current density of 200 Am^2. It was found that the microstructure of the steel plays a role on the generation of hydrogen induced martensitic phases and surface micro cracks. Both kinetics were slower on a pre-cold rolled steel.

36771 (INIS-BR—1017) Construction and fabrication of a hot X-ray diffraction chamber for studying the reaction between Nb-Ti and N_2. Teixeira, Silvio R.; Rodrigues, J.A.; Mascarenhas, Y.P. (UNESP, Presidente Prudente (Brazil). Dept. de Ciencias Ambientais). 1986. 5p. (In Portuguese). (CONF-8609421—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702762/JAW.

From Meeting about gases in metals and alloys; Sao Carlos, Brazil (24 Sep 1986).

An high temperature chamber for the X-ray diffraction of UNESP-Presidente Prudente, in Brazil, to study the reaction between the Nb-Ti alloy and the nitrogen gas, was constructed. The phases formed during the reaction are identified, the alterations of lattice parameters during the formation of metal-gas solid solution solution are observed, and information on Kinetic and the advance of nitridation from the surface to the interior of these sample. (M.C.K.).

36772 (INIS-BR—1018, pp 9) **Development of a new type of NbTa electrolytic capacitor.** Gomes, U.U.; Pinatti, D.G. (Rio Grande do Norte Univ., Natal (Brazil). Dept. de Fisica; Fundacao de Tecnologia Industrial, Lorena (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

36773 (INIS-BR—1024) **Weldability study of the structural steel of the Angra II reactor containment.** Santos Pinto, M. dos. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1980. 81p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702289/JAW.

A weldability study of the german steel WSTE-51 based on mechanical, metallographic, hardness as well as special tests such as the CTS, the Tekken, for cold cracking, and the Vinckier test for reheat cracking is presented. The welding process used was the manual metal arc with low hydrogen eletrodes. In order to broaden the scope of this study the properties of weldments fabricated by submerged arc welding with high and low heat input were analized by means of mechanical and metallographic tests. The results showed that the joints had good quality and emphasize the necessity of special care in order to avoid cold cracking as well as the use of a temperbead in order to avoid reheat cracking. The submerged arc welding study concludes that higher impact resistance in the HAZ is obtained with low heat imput.

36774 (INIS-BR—1072) **Influence of martensitic phase in abrasion behaviour of stainless steel 304 L.** Ruzzante, J.; Alvarez, P.; Hey, A.; Gestido, G.D.; Vosen, J.H.; Fernandez, H.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1986. 19p. (In Spanish). (CONF-8611238—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702770/JAW.

From 41. annual congress of the Brazilian Association of Metals; Sao Paulo, Brazil (9 Nov 1986).

Abrasion behaviour is studied in commercial stainless steels of different class compositions by standard. The work achieved guieds in structural analysis of superficial coat formed and its relation with abrasion variables, load and velocity. The abrasion is made in an equipment LF WK of high velocity with friction powers, abrasion velocity and temperature variation registered on the tested piece. The abrasion zone is studied with scanning electron microscope (SEM). The deformed superficial zone nature is studied relationing its microstructure with profile corresponding of microhardness. (C.M.C.T.R.).

36775 (INIS-BR—1102) **Preparation and testing of Nb-Zr and Nb-ZrO^2 single crystals for deformation studies.** Botta Filho, W.J.; Christian, J.W.; Taylor, G. (Sao Carlos Univ. (Brazil). Dept. de Engenharia de Materiais). 1987. 16p. (CONF-8710277—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702798/JAW.

From 42. annual congress of the Brazilian Association of Metals; Salvador, Brazil (18 Oct 1987).

The difficulties to obtain adequate single crystals of Nb-Zr and Nb-ZrO_2 alloys for deformation studies are discussed. Low-temperature internal oxidation of Nb-Zr alloys followed by ageing at higher temperatures resulted in the precipitation of ZrO_2 particles. However, the effect of this treatment on the particles size and distribution and on the crystallographic structure of the particle was not completely understood. Compression tests in the temperature range 4.2K to 373K showed a small effect of zirconia particles on the mechanical properties of Nb-Zr solid solutions and a significative effect of the amount of oxygen remaining in solid solution after the oxidation treatment.

36776 (INIS-BR—1103) **Microsegregation and homogenization in U-Nb alloy.** Leal, J. Fernando; Nogueira, R.A.; Ambrozio Filho, F. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. 19p. (In Portuguese). (CONF-8710277—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702799/JAW.

From 42. annual congress of the Brazilian Association of Metals; Salvador, Brazil (18 Oct 1987).

Microsegregation results in U-4 w t% Nb alloys casted in nonconsumable electrode arc furnace are presented. The microsegregation is studied qualitatively by optical microscopy and quantitatively by electron microprobe. The degreee of homogenetization has been measured after 800°C heat treatments. The times required for homogeneization of the alloys are also discussed.

36777 (INIS-mf—11718) **Magnetic properties of heavy-fermion superconductors.** Rauchschwalbe, U. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich 5 - Physik). 5 Dec 1986. 197p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753554/JAW.

In the present thesis the magnetic properties of heavy-fermion superconductors are investigated. The magnetoresistance and the critical magnetic fields show a variety of anomalous phenomena. The Kondo lattices $CeCu_2Si$ and $CeAl_3$ are analysed by magnetoresistance and the field dependence of the resistivitis of UBe_{13}, UPt_3, URu_2Si_2 and $CeRu_2Si$ are measured for temperatures < or approx. 1 K. (BHO).

36778 (JINR—14-87-30) **Results and perspectives of investgtigations at the accelerators in LNR of JINR of high-energy ion irradiation influence on structure, deformational and strength metal and crystal properties.** Regel', V.R.; Vorob'ev, E.D.; Didyk, A.Yu.; Skuratov, V.A.; Shchegolev, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702128/JAW.

The review on radiation material test in LNR of JINR at heavy ion accelerators are given. The description of experimental methods, which can permit to study different material properties at heavy ion irradiation is presented. The results on different crystals, metals and alloy investigations, irradiated by ions with energies from 1 to 10 MeV/nucleon are considered. 24 refs.; 8 figs.

36779 (JINR—R-13-87-525) **Investigation of hydrogen isotope penetration through stainless steels Kh18N10T and Kh13M2BFR.** Bystritskij, V.M.; Dzhelepov, V.P.; Granovskij, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702189/JAW.

Submitted to the journal At. Energy.

Compared are the parameters of hydrogen and deuterium penetration through austenitic (Kh18N10T) and ferritic-martensitic (Kh13M2BFR) steels measured at high saturation and at the gas pressure to 5000 at in the temperature range 300-1050 K. The conclusion is made that the given steels can be applied as materials for pressure vessels only in pressure range investigated. 5 refs.; 7 figs.; 2 tabs.

36780 (JINR-E—8-87-577) **Low temperature long-time relaxation in glasses.** Sahling, S.; Sahling, A.; Kolac, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702914/JAW.

Submitted to the journal J. Solid State Comm. .

The analysis of low-temperature long-time heat release experiments for amorphous materials (SiO_2, $Fe_{80}B_{14}Si_{16}$; $Co_{82}Fe$/sub 4.5/Cr_2Si/sub 2.5/$B_2$2) at temperatures above 1K is presented. The essential deviations from the tunneling theory in this temperature range can be explained by the assumption of maximum energy E/sub f/ which limits the energy distribution of tunneling states and the height of potential barriers. E/sub f/ is only slightly material dependent (7.5K ≦ E/sub f/ ≦ 24K). The results are consistent with the theory of soft potentials. 16 refs.; 2 figs.; 1 tab.

36781 (JINR-R—17-87-187) Heat capacity of a thick superconducting plate with proximity effect. Ivanov, N.B.; Mishonov, T.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702947/JAW.

Submitted to the journal Phys. Status Solidi B.

It is shown that within the framework of the Ginzburg-Landau theory the plane defects may smear the superconducting phase transition in manner similar to the smearing connected with the thermal fluctuations in disordered systems. If defects stimulate the appearance of a coherent phase at T > T/sub c/, the heat capacity formula C/sub s/-C/sub n/=constxchemical bondT-T/sub c/chemical bond^{-1}2 contains only bulk parameters. 7 refs.

36782 (KFK—4309) Effect of additives on the metallurgical and superconducting properties of Nb_3Sn wires. Drost, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik; Karlsruhe Univ. (T.H.) (Germany, F.R.)). Sep 1987. 116p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753579/JAW.

For Nb_3Sn wires the effect of additives Fe, Ni, Ta, Ti, Ga, Zn and H on the metallurgical and superconducting properties is studied. For comparison the wires were prepared under identical conditions. For Fe and Ni additives to Nb a reduced growth of A 15 compound layer is observed in contrast to Ti additives. Auger analysis of Nb_3Sn layers reveal a remarkable diffusion profile for the Ti additive, showing a concentration step at the interface between the Nb core and the Nb_3Sn layer. The paramagnetic additives Fe and Ni cause an enhancement of the high field critical current densities (for B > 11 T) similar to the well known Ta and Ti additives. For the first time this work presents residual resistivity values for Nb_3Sn filaments prepared by the bronze process. On fully reacted filaments an increase of the residual resistivity form rho_0=15 $\mu\Omega$cm for the binary Nb_3Sn to 40 $\mu\Omega$cm for Ti alloyed Nb_3Sn (1.3 at %) is found. The investigations furnish a strong evidence for the correlation between rho_0 and the enhancement of B/sub c2/ in alloyed Nb_3Sn wires, which is derivable from the GLAG-theory. (orig.GSCH).

36783 (LA—11065) High-strain-rate, high-temperature biaxial testing of DOP-26 iridium. George, T.G. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 47p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010471/JAW.

High-strain-rate biaxial punch tests were performed on DOP-26 (Ir-0.3 wt.% tungsten) iridium-alloy disc given annealing and aging heat treatments. Test temperatures ranged between 600 and 1440{degree}C, and punch velocity was held constant at 45 m/s. Three types of samples were evaluated: Z-batch old-process discs, B-batch old-process discs, and B-batch new-process discs. The results indicate that batch-to-batch variations in ductility are significant and that new-process iridium is slightly more ductile than old-process material. 12 refs., 43 figs., 26 tabs.

36784 (LA-UR—88-625) Influence of peak pressure on the substructure evolution and shock wave profiles of Ti-6Al-4V. Gray, G.T. III; Morris, C.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880681—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88006458/JAW.

From 6. world conference on titanium; Cannes, France (6 Jun 1988).

The object of the present study was to investigate the influence of peak pressure on the residual structureproperty relationships and the wave profile behavior of shock-loaded Ti-6-4. A further aim of the present work was to determine if the alpha to omega phase transformation occurred in Ti-6-4 using {open+-quotes}real time{close+-quotes} VISAR and post-mortem shock recovery techniques. The following conclusions can be drawn: over the velocity range investigated no evidence of an alpha to omega phase transition was observed in Ti-6-4 with either VISAR wave profiles or shock recovery experiments; increasing peak pressure results in an increased dislocation density and yield strength in shock-loaded Ti-6-4; deformation of the (1121) type, are observed in the 10 and 13 GPa; the low pressure Hugoniot for Ti-6-4 is given by U/sub s/ = 5.123 kms + 1.083 U/sub p/ for U/sub p/ < 1.4 kms; the high pressure relation is given by U/sub s/ = 5.030 + 1.056 U/sub p/. 9 refs., 5 figs.

36785 (LA-UR—88-1556) Scaling of the magnetoresistance of UBe_{13} under pressure. Willis, J.O.; McElfresh, M.W.; Thompson, J.D.; Smith, J.L.; Fish, Z. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-880703—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011054/JAW.

From Joint INTERMAG/magnetism and magnetic materials conference; Vancouver, Canada (11 Jul 1988).

We report magnetoresistance measurements of the heavy electron compound UBe_{13} above the superconducting transition temperature T/sub c/ and below 4 K for pressures P up to 19 kbar and for magnetic fields H up to 9T. We observe strong negative magnetoresistance at all pressures and temperatures. The resistivity {rho} is quadratic in temperature T from T/sub c/ up to a maximum temperature of 1 K at 1 bar increasing to 2 K at 19 kbar. The slope of the T^2 term decreases with both H and with P. We find that δ(H) {triple+-bond} {minus} ({rho}(H) {minus} {rho}(0)){rho}(0) for a given pressure scales as a function of HT and exhibits power law behavior over one decade with an exponent of 1.7. In addition, δ(H) at high pressure shows this same power law over a more limited HT range. 16 refs., 5 figs.

36786 (LA-UR—88-1601) Neutron irradiation study of Nd-Fe-B permanent magnets made from melt-spun ribbons. Brown, R.D.; Cost, J.R.; Meisner, G.P.; Brewer, E.G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880703—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88011053/JAW.

From Joint INTERMAG/magnetism and magnetic materials conference; Vancouver, Canada (11 Jul 1988).

Radiation-induced changes in the magnetization of sintered Nd-Fe-B permanent magnets are known to vary widely among specimens produced by different manufacturers. Samples of Nd-Fe-B MAGNEQUENCH magnets, which are made from melt-spun ribbons, have now been studied and show a much reduced sensitivity to neutron irradiation than do sintered Nd-Fe-B magnets. All melt-spun ribbon-based MAGNEQUENCH magnets, i.e., epoxy-bonded, hot-pressed, and die-upset magnets, show essentially the same slow decrease in magnetic remanence with neutron dose. Measurements of the open-circuit remanence B/sub r//B/sub ro/ at various times during the irradiation show a decay of only 1.5% of the preirradiated value for the MAGNEQUENCH magnets after 1 hour of irradiation, or a dose of 1.4 {times} 10^{18} neutrons/cm^2, compared to a 4.6% drop in remanence for the best sintered Nd-Fe-B magnet (Sumitomo 30H) with the same irradiation dose. Moreover, after 5.3 hours of irradiation, the remanence drops by only 3% for the MAGNEQUENCH magnets. Magnets made from melt-spun ribbons are thus the least sensitive to neutron irradiation so far measured for Nd-Fe-B permanent magnets, but are somewhat more sensitive than samarium-cobalt magnets. 12 refs., 1 fig.

36787 (LBL—24512) A method for determining the solubility of hydrogen in molten aluminum-lithium alloys. Verma, T. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 60p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009807/JAW.

A constant volume technique, involving the measurement of differential pressure generated between a control volume subjected to an inert gas and an "active" volume subjected to hydrogen, has been used to determine the solubility of hydrogen in molten 2090 aluminum lithium alloys. The solubility of hydrogen in 2090 aluminum lithium alloys obeys Sievert's law and lies between 1-6 ppM for pressures varying from 250-950 mm Hg in the temperature range 650-750{degree}C. The heat of dissolution of hydrogen is of the order of 135 kJ mol^{-1}in this alloy.

36788 (LBL—25022) Weldability of 2090 Al-Cu-Li alloy. Sunwoo, A.J.; Morris, J.W. Jr. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 24p. (CONF-8804142—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011963/JAW.

From American Welding Society meeting; New Orleans, LA, USA (18 Apr 1988).

The weldability of 2090 was studied along with the metallurgical changes associated with welding and aging. Autogenous bead-on-plate welds are produced using two different base metal tempers, as-received condition (T3) and peak-aged condition (T8) and two different welding processes, GTAW and EBW. The optimum aging condition is determined for the EB and GTA weldments. The results of weldability and aging studies indicate that the best aging temperature for the base metal and EB weldments is 160°C, which results in a 75% joint efficiency and for the GTA weldment is 190°C, which produces a 55% joint efficiency. Aging at 230°C leads to a serious deterioration in the properties. The distribution of precipitates in the fusion zone appears to be the primary factor in controlling the weldment strength and elongation.

36789 (LBL—25031) Ion-implantation of reactive elements in improving the adhesion of thermally grown Cr_2O_3 scales. Hou, P.Y.; Stringer, J. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 18p. (CONF-8804117—1; CONF-8804117—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009818/JAW.

From Adhesion in solids; Reno, NV, USA (5 Apr 1988).

The high-temperature oxidation behavior of Al, Y and Hf ion-implantation in Ni–25wt%Cr alloy with dosages ranging from 10^{15}–10^{17} ionscm^2 has been studied. Results are compared with the unimplanted alloy, a Xe-implanted alloy and alloys with 0.2wt% Y or 1wt% Al additions. Oxidation tests were carried out at 1000{degree}C and 1100{degree}C in 1 atm. O_2. It is found that the ion-implantation of Y and Hf greatly reduced oxidation rate and improved scale adherence after a critical implantation dosage, {approximately}1 {times} 10^{16} ionscm^2, has been reached. The improved scale adhesion is attributed to both a reduction in growth stress and a strengthened scalealloy interface, which all developed as a result of a modified scale growth process. 8 refs., 6 figs., 1 tab.

36790 (LBL—25050) Long-range structural effects in the anomalous voltammetry of Pt.3. Ross, P.N. Jr. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 34p. (CONF-8708253—1; CONF-8708253—). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010782/JAW.

From Symposium on molecular phenomena at electrode surfaces; New Orleans, LA, USA (30 Aug 1987).

The history of the observation of anomalous voltammetry is reviewed and an experimental consensus on the relation between the anomalous behavior and the conditions of measurement (e.g., surface preparation, electrolyte composition) is presented. The behavior is anomalous in the sense that features appear in the voltammetry of well-ordered Pt(111) surfaces that had never before been observed on any other type of Pt surface, and these features are not easily understood in terms of current theory of electrode processes. A number of possible interpretations for the anomalous features are discussed. A new model for the processes is presented which is based on the observation of long-period ice-like structures in the low temperature states of water on metals, including Pt(111). It is shown that this model can account for the extreme structure sensitivity of the anomalous behavior, and shows that the most probable explanation of the anomalous behavior is based on capacitive processes involving ordered phases in the double-layer, i.e., no new chemistry is required.

36791 (ORNL/M—548) Nickel aluminides: A new family of nickel + aluminum alloys featuring simple composition, low density, excellent oxidation resistance, and high yield strength that increases with temperature. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010692/JAW.

The three alloys presented in this brochure are based on the intermetallic compound Ni_3Al. Ni_3Al is brittle, but by changing the composition to $Ni_{76}Al_{24}$ and adding {approximately}200 ppM boron the alloy becomes ductile. The strength of these alloys depends entirely on the behavior of the ordered crystal structure and the grain size. Larger grain size favors good high temperature strength and fine grain size favors good low temperature strength. An unusual feature of the strength is that in annealed material the yield stress increases with test temperature up to about 800{degree}C. Nickel aluminides display excellent oxidation and corrosion resistance characteristics which can be further enhanced with simple additives. Forming and processing can be accomplished by a variety of methods. Molten aluminides can be formed into ingots, castings, and near net shapes by several different processes. Nickel Aluminides can also be produced and consolidated from powder. Both cast and powder ingots, sheet, tube hollows, and rod can be further processed in several ways.

36792 (ORNL/TM—10548) Calculation of the specific and volumetric enthalpies of Ge-Si alloys. Alexiades, V.; Wichner, R.P. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 35p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008949/JAW.

A procedure is developed for the calculation of specific and volumetric enthalpies of Ge-Si alloys as an initial step in the evaluation of these materials for heat storage in solar dynamic power systems. The calculation is based on the thermodynamics of non-ideal solutions and the reported {open←quotes}regular{close←quotes} nature of liquid and solid Ge-Si solutions. With only minor modifications, all of the other thermodynamics properties of this alloy system may additionally be evaluated. Use of Ge-Si alloys for heat storage purposes in solar receivers entails both negative and positive aspects. The negative aspects relate largely to the non-congruent nature of the phase change process which precludes isothermal heat delivery. However, on the positive side are high thermal conductance, low volume change on melting, and the availability of a range of heat delivery temperatures by modification of only the alloy composition.

36793 (PB—88-864012/XAB) Neodymium-Iron-Boron (Nd-Fe-B) permanent magnets. January 1984-May 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1984-May 1988. (National Technical Information Service, Springfield, VA (USA)). May 1988. 111p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the development, fabrication, and applications of neodymium-iron-boron (Nd-Fe-B) permanent magnets. Topics include magnetization and aging of magnets, crystal structure and magnetic properties, coercivity of Nd-Fe-B magnets, magnetic hardening mechanism, and high and low temperature properties of Nd-Fe-B magnets. Applications of Nd-Fe-B permanent magnets in electrical machines, magnetomechanical devices, and medical and dental devices are presented. (Contains 204 citations fully indexed and including a title list.)

36794 (RFP—4220) Wettability of brazing alloys on molybdenum and TZM [Mo-Ti-Zr alloy]. McDonald, M.M.; Keller, D.L.; Heiple, C.R.; Hofmann, W.E. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1988. Contract AC04-76DP03533. 30p. (CONF-8804142—1). NTIS, PC A03;3. Order Number DE88010900/JAW.

From American Welding Society meeting; New Orleans, LA, USA (18 Apr 1988).

Vacuum brazing studies have been performed on molybdenum and TZM (0.5Ti-0.08Zr-Mo). Wettability tests have been conducted for nineteen braze metal filler alloys on molybdenum and thirty-two braze metal filler alloys on TZM over a wide range of temperatures. A wetting index, which is a function of contact angle and braze alloy contact area, was determined for each filler alloy at each brazing temperature. The nature and extent of interaction between the brazing alloys and the base metals was analyzed by conventional metallography, scanning-electron microscopy, and electron microprobe analysis. A comparison is made between the behavior of filler alloys on molybdenum and TZM -- filler alloys consistently exhibited less wettability on TZM than on molybdenum. The lower wettability of TZM is believed to be due to a small

amount of titanium in the surface oxide on TZM. Cracking was observed in the base metal under some of the high temperature braze deposits. The cracking is shown to arise from liquid metal embrittlement from nickel in the high temperature braze alloys. 7 refs., 11 figs., 2 tabs.

36795 **(SAND—87-1818) Stress relaxation of a titanium (Ti-6Al-4V) threaded joint.** Stephens, J.J.; Munford, J.W. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 24p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010102/JAW.

The amount of load relaxation which can be expected in the W88 Titanium Mounting Ring is summarized. We have performed analytical estimates of the amount of stress relaxation under uniaxial loading conditions, using room temperature creep data for Ti-6A1-4V alloy which was generated in support of previous Sandia programs. In addition, we performed load-relaxation experiments up to 1000 hours duration on torque-loaded model components in order to evaluate experimentally the amount of load relaxation under loading conditions which are identical to those experienced by the mounting ring. Results of both approaches indicate that the amount of load relaxation during a thirty-year component life will not be enough for concern.

36796 **(SAND—87-2541C) Friction, wear and electrical contact resistance of precious metal alloys.** Pope, L.E.; Peebles, D.E.; Barton, B.M. (Sandia National Labs., Albuquerque, NM (USA); Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00789. 29p. (CONF-880317—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011244/JAW.

From ASM symposium on engineered materials for advanced friction and applications; Gaithersburg, MD, USA (1 Mar 1988).

The preferred selection of precious metal electrical contact materials depends on the contact geometry, contact stress, test ambient values of electrical contact resistance and whether friction and/or wear must be controlled. Wiper-type contact couples that operate in dry hydrocarbon-free atmospheres, particularly if low and steady friction coefficients and minimal wear are required, are typically that of a palladium alloy pin (ASTM B540) sliding on a gold alloy plate (ASTM B541). These materials have a contact resistance of approximately ten milliohms and a friction coefficient less than 0.5 for the most common operational environments. Segregation of sulfur up to a few atomic percent to wear tracks formed on the gold alloy is not detrimental. The accumulation of larger concentrations of sulfur can form surface films of cuprous sulfide which increases the contact resistance to a few tens of milliohms. Large electrical contact resistances (greater than one ohm) are measured only when rider wear becomes dominant and ridges of Pd-containing material are formed in wear tracks. Ion implantation of carbon into the Au alloy decreases the friction coefficient without increasing the electrical contact resistance. In contrast, the implantation of nitrogen into the Au alloy increases the friction coefficient, but does not change the electrical contact resistance. In ambients containing hydrocarbons, the implantation of carbon is not recommended because it promotes friction polymer formation. 19 refs., 5 figs., 8 tabs.

36797 **(SAND—87-2761C) Initiation of explosive molten aluminum-water interactions at wet or underwater surfaces.** Nelson, L.S.; Eatough, M.J.; Guay, K.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880724—7). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88004686/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

In certain metallurgical operations, molten aluminum may inadvertently contact a wet or underwater solid surface. Occasionally, depending on the nature of the surface and contact conditions, an explosive melt-water interaction may be initiated. These interactions are sometimes attributed to the entrapment of water between the melt and the surface. In this work, we have used laboratory experiments to investigate these surface initiations. By coupling our results with the literature of boiling and bubble nucleation, we are able to propose and support a mechanism for the initiation of these vigorous interactions. The mechanism involves superheating of a thin layer of liquid water enclosed between the melt and a water-wettable solid surface, followed by explosive vaporization. Because nonwettable surfaces offer copious bubble nucleation sites, superheating is suppressed and the explosions are reduced or eliminated at hydrophobic surfaces. 15 refs., 2 figs., 2 tabs.

36798 **(SAND—87-2791C) Diffusion models of crack growth due to random overloads.** Winterstein, S.R.; Veers, P.S. (Stanford Univ., CA (USA). Dept. of Civil Engineering; Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880587—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008811/JAW.

From ASCE specialty conference on probabilistic mechanics and structural safety; Blacksburg, VA, USA (25 May 1988).

For certain random vibration loads, crack growth may be adequately estimated with random load models that ignore sequence effects. ASTM test results have been accurately predicted from narrow-band (Rayleigh) load models; analytical results may also include bandwidth effects and racetrack cycle-counting (Veers, 1987) and non-Gaussian loads (Winterstein, to appear). Systematic tensile overloads may produce greater load sequence effects. These are predicted from simple diffusion models, which estimate the crack-opening stress from plastic zone considerations. The reset stress has been fixed during retarded growth; more generally, a {open quotes}steady-state{close quotes} reset stree distribution can be estimated from diffusion theory (Veers, 1987). In general as overload variability (Vγ) increases, overload-affected regions overlap more often and net retardation is less. Therefore, the assumption of regular overloads, common in fatigue block-load testing, may generally be unconservative. 9 refs., 2 figs.

36799 **(SVF—281) Experience of corrosion and corrosion protection of the seawater systems of Swedish thermal power plants.** Henriksson, S. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Oct 1987. 45p. (In Swedish and English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753350/JAW.

The sea water structures comprised are screen houses, piping, condensers and other heat exchangers, pumps and valves. In addition information is given about non-asbestos gasket materials used in the sea water systems. The severest corrosion problems were caused by the heat exchangers as long as they were equipped with tubes of aluminium brass and 90/10 cupro nickel. This was of particular importance in the nuclear power plants because of their high demand of operational safety. Most of these problems have been solved by the widespread use of titanium in condensers and other critical heat exchanger positions. Direct cooling with sea water has also been replaced by fresh water cooling from secondary systems cooled by plate or tubular heat exchangers of titanium. In fossil peak-load plants with short annual operational times aluminium brass condenser tubes can still be justified from an economic point of view. The corrosion of screen house equipment and sea water pumps is generally suppressed well enough by cathodic protection. Sea water pipes and valves, usually of carbon steel or cast iron with rubber lining or solvent-free epoxi coating, do not cause serious corrosion problems. The most frequent gasket material in the sea water systems is solid rubber. Plastic reinforced rubber is also used to some extent but the experience is limited for the present.

36800 **(SVF—282) Corrosion tests of stainless steels in chlorinated sea water at 45 degrees C.** Henriksson, S. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Nov 1987. 42p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753351/JAW.

To supplement previous corrosion tests of high alloy stainless steels in chlorinated seawater at 35 degrees C three Swedish stainless steels - Avesta 254 SMO, Avesta Monit and Sandvik Sanicro 28 - have been tested at 45 degrees C in North Sea water continously chlorinated with 0.5 and 2.0 ppm chlorine. The most important results can be summarized as follows: - Tubes of the steel 254 SMO, which are seal welded to tube sheets of austenitic stainless steels, are resistant to localized corrosion even at 45 degrees C. - The fully ferritic steel MONIT has to be seal welded to austenitic

tube sheets with an overalloyed austenitic filler (Inconel 625 type) in order to avoid corrosion of the welds. - The steel 254 SMO, which was fully resistant to crevice corrosion in simulated flange joints at 35 degrees C, exhibits at 45 degrees C a tendency to superficial crevice attack. - There is no important difference in the galvanic corrosion behaviour of NiAl-bronz (UNC C95500) in contact with the steel 254 SMO at 35 and 45 degrees C. Decreasing the chlorine content from 2.0 to 0.5 ppm, however, reduces the corrosion rate considerably.

36801 **(UCID—21395) Rocket-propellant burn tests of silicide-coated niobium and tantalum.** Curtis, P.G.; Krikorian, O.H.; Helm, F.H. (Lawrence Livermore National Lab., CA (USA)). 20 Apr 1988. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010729/JAW.

Coatings designed to protect refractory metals in fire situations were tested on niobium and tantalum in a furnace and in a rocket-fuel flame. The best performance was obtained from Cr-Si-type silicide coatings applied by the pack-cementation process. The main mode of failure of the coated parts was corrosion by molten stainless steel rather than oxidation.

36802 **(UCRL—96445) Formation of metastable structures and amorphous phases in Cu-W alloys using the triod sputtering technique.** Rizzo, H.F.; Tanner, L.E.; Wall, M.A.; Massalski, T.B.; McClanahan, E.C. (Lawrence Livermore National Lab., CA (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA); Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract W-7405-ENG-48. 13p. (CONF-871124—100). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009051/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The triode sputtering technique and a {open←quotes}split-target{close←quotes} arrangement were used to produce metastable crystalline and amorphous phases in the Cu-W system under essentially oxygen-free conditions. Large metastable extensions of solid solubility were observed both from the Cu (fcc) and W (bcc) sides of the phase diagram, and a wide range of metallic glass formation was observed, approximately between 30 and 65 at. % W. The thickness of the amorphous Cu-W phase (40-160μm) that can be deposited without the formation of the metastable bcc phase appears to be dependent on the Cu-W alloy composition. On heating, the crystallization temperature of the amorphous alloys was higher than 350{degree}C. The behavior of the lattice parameter and near-neighbor distance has been studied with x-ray diffraction, showing small positive deviations from an assumed Vegard's Law. Hardness measurements indicate that the metastable crystalline phases are relatively harder than the amorphous phase. 11 refs., 9 figs.

36803 **(UCRL—96638-Rev.1) Studies of internal stresses and surface roughness of sputtered Be and BeB films.** Hsieh, E.J.; Gillespie, C.H.; Pierce, E.L.; Hatcher, C.W. (Lawrence Livermore National Lab., CA (USA)). 26 Oct 1987. Contract W-7405-ENG-48. 9p. (CONF-871125—25-Rev.1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011737/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

Beryllium is a low-Z metal which has a wide application in laser fusion. Recent studies have shown that the survivability of thin film coated optical mirrors against the prompt deposition of x-rays can be enchanced by inserting a beryllium "heat sink" layer between the reflective coating and the substrate. In both applications, the coating surface smoothness and internal stresses are important properties to be controlled by deposition parameters. In this study, we measured the film stresses and surface smoothness as a function of sputtering pressure. These data will allow us to select the best set of coating parameters for a given application. 4 refs., 2 figs.

36804 **(UCRL—97649) Fast transient thermophysical measurements at Livermore.** Gathers, G.R. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 33p. (CONF-880606—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011726/JAW.

From 10. symposium on thermophysical properties; Gaithersburg, MD, USA (20 Jun 1988).

The development of the Isobaric Expansion Experiment at Lawrence Livermore National Laboratory is described. Rod samples are self heated by current from a capacitor bank while current and sample voltage, sample cross section and temperature are measured continuously as functions of time. The system allows nearly complete thermodynamic characterization of a material along an isobar in a single shot. The pressure of the isobar is determined by containing the sample in argon gas at a predetermined ambient pressure. Correlation of the measured quantities allows elimination of time as a common parameter. Quantities corresponding to a given time are taken to refer to a single equilibrium state. Temperature stagnation and volume and resistivity changes during phase transitions may be seen and allow the heat of transformation and the slope of the phase line in the P, T plane to be determined. Other derived quantities are specific heat c/sub p/, volume corrected electrical resistivity and bulk thermal expansion coefficient. A special advantage of the technique is that all quantities are measured on the same sample in a single experiment. The short time duration of the measurements allows access to a temperature range beyond that available to slower methods.

36805 **(UCRL—98230) The preparation of mechanically alloyed powders for TEM [transmission electron microscopy] examination.** Kamenetzky, E.A.; Wall, M.; Castro, R.; Tanner, L.E. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). 12 Feb 1988. Contract W-7405-ENG-48;AC03-76SF00098. 7p. (CONF-871124—99). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008043/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Transmission electron microscopy (TEM) specimens of mechanically alloyed elemental Ni and Nb powders are prepared by a new procedure. The alloyed powders are mixed with smaller Al powder and fill an aluminum ring (3 mm outer diameter). This composite is cold pressed together with the Al powders taking most of the deformation. The compacted specimen can be mechanically thinned. Electropolishing and ion milling can then proceed by standard methods with special precautions to minimize differential polishing or milling rates. Microstructural aspects of the formation of an amorphous phase by high-energy ball milling these powders have been studied. After 6 h each particle transforms to a heterogeneous layered composite of particles of one element in the matrix of the other. Particle size ranges from 15 nm to 90 nm. Mechanical alloying for 36 h results in the formation of an apparently uniform phase interspersed with a few small (4 nm to 30 nm) elemental crystalline particles. 9 refs., 4 figs.

36806 **(UCRL—98232) On the systematics of phase transformation in metallic alloys.** Tanner, L.E. (Lawrence Livermore National Lab., CA (USA)). 12 Feb 1988. Contract W-7405-ENG-48. 10p. (CONF-880586—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008041/JAW.

From Conference on competing interactions and microstructures, statics, and dynamics; Los Alamos, NM, USA (5 May 1988).

Phase transformations in metallic alloys proceed by diffusional replacive or diffusionless displacive mechanisms. These are generally viewed as independent processes without significant interactive coupling. However, new studies of displacive transformations, particularly regarding pretransformation phenomena, suggest that such coupling may indeed occur. If so, it should have a significant effect on the mode, morphology and mechanisms of the replacive transformations. In this paper we examine these possibilities in light of the most recent observations and thinking in this field.

36807 **Gruenelsen gamma and acoustic velocity for soft sphere fluids.** Shaner, J.W. (Los Alamos National Laboratory, Shock Wave Physics Group, Group M-6, MS J970, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* 89: No. 3, 1616-1624(1 Aug 1988).

New experimental and computational methods make possible measurement or simulation of the thermodynamic properties of fluids over wide ranges of temperature and density. We use a

model for fluid thermodynamics based on the (1/r)/sup n/ repulsive potential to show qualitatively what behavior one might expect for measurements of Grueneisen's gamma and acoustic velocity for compressed and expanded fluid metals and molecular fluids. We find limited regions of validity for such empirical rules as rhoγ/sub G/ = constant and linear density dependence of sound velocity. These results are compared with experimental data for fluid metals, and with N_3 simulations presented in the accompanying paper.

36808 **Glancing-angle extended x-ray-absorption fine structure and reflectivity studies of interfacial regions.** Heald, S.M.; Chen, H.; Tranquada, J.M. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 2, 1016-1026(15 Jul 1988).

Glancing-angle extended x-ray-absorption fine structure (EXAFS) and x-ray reflectivity measurements have been made for a Au surface and several Cu/Al interfaces. The Cu/Al samples consisted of 1000 A Al on Cu, and the measurements demonstrate the potential of these techniques for determining interface structure and morphology. In particular, distinct differences were observed in both the reflectivity and interface EXAFS signals for Cu/Al samples prepared under different conditions. The information obtained on these samples is compared with information obtained by transmission electron microscopy, Rutherford backscattering, and Auger sputter profiling, and excellent agreement is found. The glancing-angle measurements are distorted by anomalous dispersion effects and a simple analytic correction scheme is presented. This correction has been tested on the Au data and found to work well for the entire range of incident angles. For the Cu/Al interfaces the corrections allowed quantitative analysis of the Cu-Al bonding at the interface, and a substantial difference is found for samples prepared under UHV and non-UHV (10/sup -6/ Torr) conditions. These glancing-angle techniques offer some unique characteristics and are compared to more standard interface studies.

36809 **Relativistic calculations of 2p and 3d excitation energies in the actinide metals.** Herbst, J.F.; Wilkins, J.W. (Physics Department, General Motors Research Laboratories, Warren, Michigan 48090-9055). *Physical Review [Section] B: Condensed Matter;* **38**: No. 2, 1027-1039(15 Jul 1988).

A systematic investigation of 2p and 3d core-electron excitation energies in the actinide metals Ac—Am is described. Crystal potentials are constructed via the renormalized-atom method, and excitation energies are derived from differences between band total energies for various fixed, integral values of the 5f occupancy n. Calculations have been performed for the principal excitations, involving 6d-7s conduction-electron screening of a core hole, as well as for levels associated with 5f screening in the final state. For a given metal the principal excitation energies decrease at a rate of 4—6 eV per increment in n, while the 5f-screened levels are less sensitive to 5f occupation. The energetics of 6d-7s versus 5f screening is examined by calculations for ionized final states. We compare our findings with analogous results for core levels in the rare earth metals and with recent experimental information.

36810 **Formation of amorphous Ti alloy layers by excimer laser mixing of Ti on AISI 304 stainless-steel surfaces.** Jervis, T.R.; Nastasi, M.; Zocco, T.G.; Martin, J.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **53**: No. 1, 75-77(4 Jul 1988).

We used excimer laser radiation at 308 nm to mix thin layers of Ti into AISI 304 stainless steel. Different numbers of shots at a fluence about twice the threshold for melting varied the amount of mixing. When mixing is sufficiently complete, an amorphous surface layer is formed with Ti substituting for Fe on a one-to-one basis in the alloy. The laser mixing process, unlike Ti ion implantation, does not result in high incorporation of C in the processed layer, although some C from surface and interface contamination is incorporated into the surface layer.

36811 **Evolution of dislocation structure during inverse creep of a nickel aluminide: Ni—23.5Al—0.5Hf—0.2B (at. %).** Schneibel, J.H.; Horton, J.A. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Materials Research;* **3**: No. 4, 651-655(Jul 1988).

A well-annealed polycrystalline nickel aluminide of composition Ni—23.5Al—0.5Hf—0.2B (at. %) shows inverse creep behavior at 1033 K and 250 MPa. The minimum creep rate does not correspond to a steady-state creep condition. The increase in the creep rate with strain and time is accompanied by an increase in the volume fraction of dislocation-containing regions. The inverse transient can be eliminated by prestraining at room temperature. It is absent in the diffusional creep regime.

36812 **Effect of grain size on yield strength of Ni_3Al and other alloys.** Takeyama, M.; Liu, C.T. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Materials Research;* **3**: No. 4, 665-674(Jul 1988).

This paper analyzes the effect of grain size on yield stress of ordered Ni_3Al and Zr_3Al, and mild steels that show Lueders band propagation after yielding, using the Hall—Petch relation, σ/sub y/ = σ_0+k/sub y/ d^{-1}/sup //², and the new relation proposed by Schulson et al., σ/sub y/ = σ_0+kd/sup -(//sup p//sup +1)/2/ [Schulson et al., Acta Metall. 33, 1587 (1985)]. The major emphasis is placed on the analysis of Ni_3Al data obtained from published and new results, with a careful consideration of the alloy stoichiometry effect. All data, except for binary stoichiometric Ni_3Al prepared by powder extrusion, fit the Hall—Petch relation, whereas the data from boron-doped Ni_3Al and mild steels do not follow the Schulson relation. However, no conclusion can be made simply from the curve fitting using either relation. The results are also discussed in terms of Lueders strain and alloy preparation methods. On the basis of the Hall—Petch analysis, the small slope k/sub y/ is obtained only for hypostoichiometric Ni_3Al with boron, which would be related to a stronger segregation of boron in nickel-rich Ni_3Al. In addition, the potency for the solid solution strengthening effect of boron is found to be much higher for stoichiometric Ni_3Al than for hypostoichiometric alloys.

36813 **Sliding and thermal effects on sulfur segregation to palladium alloy contact surfaces.** Lloyd, J.N.; Vook, R.W.; Pope, L.E. (Laboratory of Solid State Science and Technology, Physics Department, Syracuse University, Syracuse, New York 13244-1130). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 4, 2462-2466(Jul 1988).

Oscillatory pin-on-plate experiments have been completed in an ultrahigh vacuum system; both pin and plate materials were a palladium alloy (ASTM B540). No enhancement of sulfur occurred in wear tracks due to 5000 wear cycles performed at room temperature in atmospheric helium. After wear tracks were formed, thermally activated segregation of sulfur to the surface was measured in wear tracks and at off-track regions. The rate of sulfur segregation was determined with Auger spectroscopy by recording the 152-eV sulfur peak height during in situ isothermal anneals. Segregation of sulfur to the surface is adequately explained by a bulk diffusion process, and a bulk diffusion constant of 2.9 +- 0.4 eV was measured for the off-track regions. This compares favorably with the bulk diffusion constants for sulfur in iron (2.2 eV), copper (1.7 eV), and silver (1.7 eV). Within wear tracks sulfur initially accumulated at a higher rate, but after a period of heating sulfur segregation rates were the same in wear tracks and at off-track regions. The initially higher rate of sulfur accumulation in wear tracks is attributed to enhanced diffusion in the deformed layer. After the deformed layer was annealed by heating, the rate of sulfur segregation was the same in wear tracks as at off-track regions.

36814 **Displacement of CO by more weakly adsorbed hydrogen on the Ni(100) surface.** Gland, J.L.; Shen, S.; Zaera, F.; Fischer, D.A. (Corporate Research Laboratory, Exxon Research and Engineering Co., Annandale, New Jersey 08801). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 4, 2426-2430(Jul 1988).

We report here hydrogen induced displacement of chemisorbed CO from the Ni(100) surface. The displacement reaction is unexpected since CO is adsorbed more strongly than atomic hydrogen on the Ni(100) surface. Hydrogen pressures of 10/sup -5/ to 10/sup -3/ Torr cause displacement of chemisorbed CO in the 309—330 K temperature range in a matter of minutes. After dis-

placement, the surface contained only the undisplaced CO and hydrogen. No surface contamination was observed either by Auger spectroscopy or temperature programmed desorption after evacuation. The rates were measured by integration of the thermal desorption spectra taken for a series of displacement times. The displacement reaction is first order in CO surface coverage with a break in rate occurring with decreasing coverage. The activation energy for the high-coverage displacement rate is ~8 +- 2 kcal/mol while the activation energy for the low-coverage displacement rate is ~12 +- 1 kcal/mol. No CO displacement is observed with either He or Ne. Adsorbed hydrogen is displaced by CO. The energetics of the displacement reaction coupled with the reaction probabilities observed suggest either direct energy transfer between the dissociating hydrogen and coadsorbed CO or substantial modification of adsorbed CO by high coverages of coadsorbed hydrogen. Using the current results we cannot distinguish between these mechanistic possibilities at present.

36815 Sliding and thermal effects on sulfur segregation to gold alloy contact surfaces. Lloyd, J.N.; Vook, R.W.; Pope, L.E. (Laboratory of Solid State Science and Technology, Physics Department, Syracuse University, Syracuse, New York 13244-1130). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 4, 2467-2473(Jul 1988).

Thermally induced surface segregation of sulfur has been measured on a gold alloy (ASTM B541). Comparisons were made among "as-received," abraded, and wear track surfaces that were ion-sputter cleaned before heating. The wear tracks were formed by oscillatory sliding at room temperature in a pin-on-plate configuration; the pin was a palladium alloy (ASTM B540). Wear tracks and heating were accomplished in situ in an ultrahigh vacuum system. The elemental compositions were measured with Auger electron spectroscopy. Previous conclusions were confirmed that sulfur segregates to wear tracks due to rubbing alone and that the source of the sulfur was the bulk material. It was found that thermal sulfur segregation was significantly greater in wear tracks than on abraded surfaces, and both wear tracks and abraded surfaces had greater thermal sulfur segregation than as-received surfaces. In the case of as-received surfaces, a highly anisotropic distribution of sulfur was observed and was attributed to enhanced diffusion of sulfur along grain boundaries and/or defects in the near-surface material. Thermal segregation was strongly influenced by the thermal treatment of the sample.

36816 Thermodynamic and kinetic basis for understanding metastable phase formation during ion-beam mixing of nickel—aluminum alloys. Eridon, J.; Was, G.S.; Rehn, L. (Department of Nuclear Engineering, The University of Michigan, Ann Arbor, Michigan 48109). *Journal of Materials Research;* **3**: No. 4, 626-639(Jul 1988).

A quantitative thermodynamic explanation for the formation of metastable phases in the nickel—aluminum alloy system through heavy-ion irradiation is presented. The role of kinetics in the transformation to a metastable state is also investigated. Experiments involved the irradiation of both layered nickel—aluminum samples and ordered intermetallic compounds with 500 keV krypton ions over a range of temperatures and compositions. Samples were formed by alternate evaporation of layers of nickel and aluminum. A portion of these samples was subsequently annealed to form intermetallic compounds. Irradiations were performed at both room temperature and 80 K using the 2 MV ion accelerator at Argonne National Laboratory. Phase transformations were observed during both in situ irradiations in the high-voltage electron microscope at Argonne and also in subsequent electron diffraction analyses of an array of irradiated samples. Metastable phases formed included disordered crystalline structures, an amorphous structure, and a hexagonal-close-packed structure. These phase structures were modeled using the embedded atom method to compute heats of transformation ΔH/sub s//sub —//sub ms/ from stable to metastable states. It was found that metastable states that have moderate heats of transformation, ΔH/sub s//sub -//sub ms/ ≃ 15%—20% of the heat of formation of the stable phase, form under irradiation. Metastable states with high heats of transformation, ΔH/sub s//sub —//sub ms/ ≃ 50% of the heat of formation of the stable phase, do not form under irradiation.

36817 Anomalous rf magnetoresistance in copper at 4 K. Rogers, J.T.; De Panfilis, S.; Melissinos, A.C.; Moskowitz, B.E.; Semertzidis, Y.K.; Wuensch, W.U.; Halama, H.J.; Prodell, A.G.; Fowler, W.B.; Nezrick, F.A.; and others. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Applied Physics Letters;* **52**: No. 26, 2266-2268(27 Jun 1988).

We have measured the effect of a magnetic field on the surface resistance of polycrystalline Cu at f = 1.2 GHz and at 4.4 K; under these conditions the surface resistance is well into the anomalous skin effect regime but has not reached its limiting value. We find that the transverse and longitudinal magnetoresistance are an order of magnitude smaller than the dc magnetoresistance and depend quadratically on the field. At low fields we observe a decrease in surface resistance with increasing field which can be interpreted as a size effect of the rf surface current, but is also typical of superconductors.

36818 Gradient terms in the Ginzburg-Landau free energy for pure and thorium-doped superconducting UBe_{13}. Brand, H.R.; Doria, M.M.; Pleiner, H. (Center for Nonlinear Studies, Mail Stop B258, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review Letters;* **60**: No. 26, 2810-2810(27 Jun 1988).

A Comment on the Letter by P. Kumar and P. Wolfle, Phys. Rev. Lett. 59, 1954 (1987).

36819 Ellipsometric studies of magnetic phase transitions of Fe-Rh alloys. Chen, L.; Lynch, D.W. (Department of Physics and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **37**: No. 18, 10503-10509(15 Jun 1988).

Spectroscopic ellipsometric measurements of the dielectric functions for Fe-Rh alloys with 48, 50, 52, and 54 at. % Fe concentrations were performed between 25 and 125 °C in the 1—3-eV range. Results show that the band structure of Fe-Rh is not drastically affected as the antiferromagnetic-ferromagnetic phase transition occurs and is less affected than band-structure calculations indicate. Therefore, the large change in the linear term of the electronic specific heat between the antiferromagnetic and ferromagnetic phases can be attributed primarily to a magnetic contribution rather than to a change in the density of electronic states at the Fermi surface.

36820 Magnetic rare-earth superlattices (invited). Majkrzak, C.F.; Gibbs, D.; Boeni, P.; Goldman, A.I.; Kwo, J.; Hong, M.; Hsieh, T.C.; Fleming, R.M.; McWhan, D.B.; Yafet, Y. (Brookhaven National Laboratory, Upton, New York 11973;). *Journal of Applied Physics;* **63**: No. 8, 3447-3452(15 Apr 1988). Contract AC02-76CH00016;AC05-84OR21400.

The magnetic structures of several single-crystal, magnetic rare-earth superlattice systems grown by molecular-beam epitaxy are reviewed. In particular, the results of recent neutron diffraction investigations of long-range magnetic order in Gd-Y, Dy-Y, Gd-Dy, and Ho-Y periodic superlattices are presented. In the Gd-Y system, an antiphase domain structure develops for certain Y layer spacings, whereas modified helical moment configurations are found to occur in the other systems, some of which are commensurate with the chemical superlattice wavelength. References are made to theoretical interaction mechanisms recently proposed to account for the magnetic states of these novel materials.

36821 Magnetic properties of rare-earth transition-metal borides. Aly, S.H.; Singleton, E.; Hadjipanayis, G.C.; Sellmyer, D.J.; Zhao, Z.R. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). *Journal of Applied Physics;* **63**: No. 8, 3704-3706(15 Apr 1988).

The magnetic and structural properties of quaternary RCo/sub 4-//sub x/Fe/sub x/B alloys with R = Nd, Sm, Er have been examined with magnetometry and x-ray diffraction. The $CeCo_4B$-type phase is found for all x in Er, for x≦3 in Sm, and for x = 0, 1, and 2 in Nd. Maximum coercivities have been obtained in a crys-

tallized $SmFe_3Co_3B$ sample with H/sub c/>17 kOe at room temperature.

36822 Low-temperature spin waves in amorphous Fe/sub 90-//sub x/Ni/sub x/Zr_{10}. Fernandez-Baca, J.A.; Lynn, J.W.; Rhyne, J.J.; Fish, G.E. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 and Center of Materials Science, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Applied Physics;* 63: No. 8, 3749-3751(15 Apr 1988). Contract AC05-84OR21400.

Inelastic neutron scattering measurements have been performed on rapid-quenched ribbons of Fe/sub 90-//sub x/Ni/sub x/Zr_{10} (x = 1,5,10) to measure the small wave-vector spin-wave spectrum. At all three concentrations a quadratic dispersion relation typical of an isotropic ferromagnet is observed, but with anomalous properties at low temperatures. For x = 5 and 10 the excitations are found to broaden considerably for temperatures ≦0.3 T/sub c/. For x = 1 the spin waves not only broaden for T≦0.5T/sub c/, but the spin-wave energies decrease monotonically with decreasing temperature while a resolution-limited quasielastic component of the scattering develops. These results are consistent with a picture of competing ferromagnetic and antiferromagnetic interactions, with reentrant spin-glass behavior evident if the frustration is sufficiently strong.

36823 Heat treatment giving a stable high temperature micro-structure in cast austenitic stainless steel. Anton, D.L.; Lemkey, F.D. (to Dept. of Energy, Washington, DC). US Patent 4,737,204. 12 Apr 1988. Filed date 10 Oct 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A heat-treated cast austenitic stainless steel alloy consisting essentially of about 13-17% chromium, about 13-17% manganese, about 1.5-2.5% molybdenum, about 1.0-2.0% carbon, about 0.5-15% niobium, about 0.5-1.5% silicon, with the balance being iron is described which is produced by the process comprising: casting the alloy; subjecting the alloy to a prebraze heat cycle treatment including heat treating the cast alloy at about 735°-785°C for about 18-22 hours followed by cooling; and subjecting the alloy to a braze cycle heat treatment including: a first stage heat treatment at about 1040°-1090°C for about 20-40 minutes followed by cooling; an optional second stage heat treatment at about 765°-815°C for about 14-18 hours followed by cooling; an optional third stage heat treatment at about 625°-675°C for about 14-18 hours followed by cooling.

36824 Scaling similarities between fracture surfaces, energies, and a structure parameter. Williford, R.E. (Battelle, Pacific Northwest Labs., Richland, WA (US)). *Scripta Metallurgica;* 22: No. 2, 197-200(Feb 1988).

Several authors have recently discussed the use of fractals to describe fracture energies and their relationships to fracture surface geometries. A fractal is a self-similar geometric construction with non-integer dimensionality. Self-similarity means that the fractal appears the same under all magnifications. Dimensionalities are described below and more rigorously. Fracture energies (E) are quantified according to the scale of observation (L), e.g., J integrals on the macroscopic scale or interatomic potentials on the lattice scale. Surface geometries have been described by roughness parameters (R) or by the fracture surface dimensionality: D/sub s/ αln(R)ln(L). Another fractal dimensionality for fracture has been defined in terms of energy: D αln(E)ln(L). A frequently employed assumption is that D/sub s/ is the same for all scales, or that a plot of ln(R) versus ln(L) is linear. However, others have found that this is in general not true for fracture surfaces. It appears that the sigmoidal scaling behavior of fracture energies could be as common as others have observed for fracture surface roughnesses. In the present work, fracture energies are found to exhibit the same sigmoidal behavior when plotted versus an apparent material structure parameter. This parameter is herein called a "characteristic structural unit for fracture" (L/sub o/). Arguments leading to this conclusion are given.

36825 Aging effects in low pressure wire chambers containing TMAE. Woody, C.L. (Dept. of Physics, Brookhaven National Lab., Upton, NY (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 493-497(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The effects of aging in multiwire proportional chambers operated at low pressure with gas mixtures containing TMAE has been studied in connection with their use as a form of readout for BaF/sub 2/ crystals in high rate environments. Aging was induced by μv light which simulated high radiation exposure to BaF/sub 2/ crystals. Measurements were made on the loss in gain as a function of the total charge removed from the anode wires under various operating conditions. The results indicate a considerable improvement over previous aging effects measured at atmospheric pressure.

36826 (AD-A—190624/7/XAB) Corrosion and electrochemical behavior of binary magnesium alloys. Mukhina, I.Y.; Timonova, M.A.; Al'tman, M.B.; Yershova, T.I. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 26 Jan 1988. Translation of Tekhnologiya Legk. Splavov, Nauch-Tekh Byull. Vses. Inst. Legk, Splavov (USSR) No. 4, 60-64(1971), by Carol S. Nack. (FTD-ID(RS)T—1384-87). 13p. NTIS, PC A03/MF A01.

A systematic investigation of the effect of 23 elements on the corrosion behavior of magnesium alloys in a 3% solution of Sodium Chloride (NaCl) and in a humid atmosphere was carried out. The values of the stationary potentials and the variation of the potentials through times are determined. The purpose of this work is to make a systematic investigation of the effect of alloying additives on the corrosion resistance and electrochemical characteristics of magnesium alloys. It is very interesting to study the corrosion behavior of binary systems, not only from the theoretical standpoint, but also from the practical one, since the selection of systems for developing corrosion-resistant alloys would be essentially random without these data. Reports give data about the effect of some elements on the corrosion and electrochemical behavior of magnesium alloys. However, the information in the literature about the systematic investigation of the effect of alloying components on the corrosion characteristics of magnesium alloys is inadequate.

36827 Science and technology of rapidly quenched alloys; Proceedings of the Symposium, Boston, MA, Dec. 1-3, 1986. Tenhover, M.; Johnson, W.L.; Tanner, L.E. Pittsburgh, PA; Materials Research Society (1987). 477p. (CONF-8612146—).

From Symposium on science and technology of rapidly quenched alloys; Boston, MA, USA (1 Dec 1986).

The present conference on the development status of rapidly-quenched alloys discusses topics in the formation and properties of amorphous metals and of rapidly quenched microcrystalline alloys, as well as the magnetic properties of rapidly quenched alloys. Attention is given to chemically produced precursors for the synthesis of amorphous metal alloy powders, the dynamics of rapid solidification in Si, bulk amorphous metals derived from metallic composites by solid-state reaction, strengthening mechanisms in consolidated amorphous alloys, the role of the melt-delivery tube in particle size control for confined gas atomization, and the effect of surface on the kinetics of Pd-Si glassy metal crystallization. Also discussed are excimer laser radiation-induced rapid solidification of Al and Al alloys, the microstructure and properties of rapidly solidified complex Ti alloys, the unusual rapidity of electron beam transient tempering, and glass formation in systems forming icosahedral quasi-crystals.

36828 Fracture behavior and microstructural characteristics of irradiated zircaloy cladding. Chung, H.M.; Yaggee, F.L.; Kassner, T.F. (Materials and Components Technology Div., Argonne National Lab., Argonne, IL 60439 (US)). pp 775-800 of Zirconium in the nuclear industry. Adamson, R.B.; Van Swam, L.F.P. Philadelphia, PA; ASTM (1987). (CONF-850601—). Contract W-31-109-ENG-38.

From 7. international conference on zirconium in the nuclear industry; Strasbourg, France (24 Jun 1985).

Zircaloy cladding tube specimens from commercial power reactor fuel assemblies (burnup >22 MWd/kgU) have been deformed to fracture at 325°C by either the internal gas-pressurization or the expanding-mandrel technique in a helium or argon environment containing no fission product species (e.g. I, Cs or CD). The fracture surfaces of ten irradiated specimens fractured by internal gas pressurization were examined by scanning electron microscopy; six specimens were found to contain various degrees of the pseudocleavage feature that is characteristic of pellet-cladding interaction failures. Out of ten test specimens fractured by expanding-mandrel loading, five were found to contain regions of pseudocleavage on the fracture surfaces. The specimens exhibited "X-marks" on the outer surface and brittle incipient cracks distributed on the inner surface, which are also characteristic of pellet-cladding interaction failures. Transmission/high-voltage electron microscope examinations of the thin-foil specimens obtained from regions adjacent to the failure sites showed that the ductile-fracture specimens were characterized by a high density of dislocations which showed normal α-vector-type Burgers vectors. In contrast, the brittle-type specimens were characterized by comparatively few dislocations which formed substructures.

36829 **Mechanistic modeling of zircaloy deformation and fracture in fuel element analysis.** Nichols, F.A. (Materials and Components Technology Div., Argonne National Lab., Argonne, IL 60439 (US)). pp 5-22 of Zirconium in the nuclear industry. Adamson, R.B.; Van Swam, L.F.P. Philadelphia, PA; ASTM (1987). (CONF-850601—).

From 7. international conference on zirconium in the nuclear industry; Strasbourg, France (24 Jun 1985).

A review is given of the comprehensive model developed in the 1960s at the Bettis Atomic Power Laboratory to explain the creep of Zircaloy during neutron irradiation and applied to fuel element analysis and design. The in-pile softening observed at low stresses was hypothesized to be due to a combination of the growth-directed Roberts-Cottrell yielding creep originally proposed for α-uranium and the formation of point defect loops preferentially on certain planes in response to the applied stress, with the second process being of relatively greater importance. The in-pile hardening observed at high stresses (or strain-rates) was proposed to be due to the cutting by dislocations of radiation-produced obstacles. In this stress (strain-rate) region, in-pile behavior was proposed to be identical to post-irradiation behavior. At intermediate stresses (strain-rates) a mechanism of radiation-enhanced climb around obstacles was suggested as being rate-controlling. As the stress is decreased, the climb process becomes easier, and the rate was then predicted to be controlled by glide at a flow-stress characteristic of unirradiated, annealed material, where radiation-enhanced diffusion enabled climbing around the normal strain-hardening obstacles. At still lower stresses, this glide process became negligibly slow compared with the growth-connected creep mechanism that was presumed to operate independently. The overall scheme was shown to be in good agreement with all the in-pile data then available and implemented into the computer analysis of fuel element behavior.

36830 **On the possible diversity of massive transformations.** Caretti, J.C. (I.M.A.F. (Facultad de Matematica, Astronomia y Fisica), Universidad Nacional de Cordoba, Laprida 854, 5000 Cordoba (AR)). *Acta Metallurgica;* **34**: No. 3, 385-394(Mar 1986).

Some features involved in the characterization of massive transformations are the crystallographic orientation relationships (OR) between matrix and product phase crystals, aspects of nucleation and growth, and the grain structure of product phases. No particular crystallographic OR seems to exist in Cu-Ga between a given matrix β crystal and the zeta/sub m/ product phase crystals nucleated within the bulk volume of the former. Only those nuclei having portions of non-coherent interfaces are likely to grow. An anisotropy in properties of the different product phase grain boundaries and migrating interfaces leads to a possible explanation for such different grain structures as the bubble-shaped pattern in Ag-Ga, and irregular pattern in Cu-Ga. It is concluded that the kinetics of atomic transfer across interfaces seems to be the most important single factor affecting the crystallographic features of nucleation. The structure and energy of product phase grain boundaries is an important factor affecting the morphology of transformation products.

36831 **High temperature creep and fracture properties of a class I solid solution alloy: Cu-2.7 at.%Sn.** Wang, J.S.; Nix, W.D. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA (US)). *Acta Metallurgica;* **34**: No. 3, 545-556(Mar 1986).

The high temperature creep and fracture properties of a class I solid solution alloy, Cu-2.7 at.%Sn, have been investigated. The alloy behaves as a class I solid solution in the normalized stress range: $1 \times 10^{-4} < \sigma\mu < 2.5 \times 10^{-3}$. Above $\sigma\mu = 2.5 \times 10^{-3}$ power law breakdown occurs whereas below about $\sigma\mu = 1 \times 10^{-4}$ the alloy exhibits class II creep behavior. In spite of the viscous nature of dislocation motion in the class I regime, the alloy fractures in an intergranular manner by cavitation along grain boundaries. However, creep ductility reaches a maximum in this regime; it decreases at both higher and lower stresses in the power law breakdown and class II creep regimes, respectively. In class I regime both creep ductility and creep strength are higher than for pure Cu. Thus, it is possible to increase both strength and ductility by forming a class I solid solution. The higher ductility is explained in terms of the difficulty of intergranular cavity nucleation.

36832 **A universal temperature scale for plastic flow.** Mecking, H.; Nicklas, B.; Zarubova, N.; Kocks, U.F. (Arbeitsbereich Werkstoffphysik und -technologie, Technische Universitat, 2100 Hamburg-Harburg (DE)). *Acta Metallurgica;* **34**: No. 3, 527-536(Mar 1986).

The strain-hardening of pure f.c.c. metals at intermediate and high temperatures is compared by analyzing the steady-state limit for <111> single crystals. The influence of the stacking-fault energy could be quantitatively accounted for by scaling the stress and temperature axes by a material dependent factor; this brought the curves for Al, Cu, Ni and Ag into coincidence for all temperatures, at a strain rate of $4 \cdot 10^{-4}\ s^{-1}$. No deviation from this universal behavior could, for example, be detected for Ag at 0.95 T/sub m/ (T/sub m/ = melting temperature), which corresponds to Al at 0.65 T/sub m/. To account for the strain-rate dependence in Al, an Arrhenius law with a stress dependent pre-exponential (exponent 3.7) led to a limiting activation energy compatible with that for self-diffusion. If this compatibility is forced onto the other materials, varying pre-exponential stress laws must be postulated. The behavior of all materials up to about 0.6 T/sub m/ follows the low-temperature description. It is concluded that dynamic recovery is influenced most significantly by dislocation rearrangements that do not require diffusion.

36833 **A simple model for the prediction of coherent and semicoherent plate precipitate habit planes.** Dahmen, U.; Westmacott, K.H. (National Center for Electron Microscopy, Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *Acta Metallurgica;* **34**: No. 3, 475-482(Mar 1986). Contract AC03-76SF00098.

A quantitative physical description of the process that determine plate precipitate habit planes evolves when a transformation with strains of mixed sign is modelled as a tensile test. The tensile axis, and with it the habit plane, is determined by elastic anisotropy in the coherent case and by slip geometry in the semicoherent case. The physical connection lies in the different constraints imposed by elastic or plastic yielding. Examples of application of the principles and comparisons with experimental observations are given.

36834 **Determination of dispersoid size distributions in Inconel MA 754 by small-angle x-ray scattering.** Stephens, J.J.; Spooner, S. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA (US)). *Acta Metallurgica;* **34**: No. 2, 303-312(Feb 1986).

The disperzoid size frequency distribution and volume fraction of the nickel based oxide dispersion strengthened alloy have been determined using small-angle X-ray scattering (SAXS). The results lead to predicted dislocation creep strengths which are in reasonable agreement with short time creep data at 1000 and

1093°C. The effect of mixed aluminum-yttrium oxides is considered.

36835 **Continuous indentation test for metals.** Jaramillo, D.V.; Kuriyama, S.; Meyers, M.A. (Dept. of Metallurgical and Materials Engineering, New Mexico Institute of Mining and Technology, Socorro, NM (US)). *Acta Metallurgica;* 34: No. 2, 313-324(Feb 1986).

A penetration test using a continuously increasing load applied on a knife-edge indenter (30° angle) is described. The advantage is that the applied load is continuously recorded as a function of penetration depth. Ni-200 and 70/30 brass with varying plastic deformation responses produced by different cold rolling and annealing schedules were studied. The finite element method was applied to model plastic deformation under the indenter and predict the load versus depth-of-penetration curves. A linear relationship between the applied load and penetration depth was found experimentally and by computer simulation.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 35711, 35820, 36760, 36919, 36961, 37264, 37407

36836 **(AD-A—189937/6/XAB) High-temperature photoelectron spectroscopy.** Dyke, J.M.; Ellis, A.M.; Feher, M.; Morris, A.; Paul, A.J. (Southampton Univ. (UK). Dept. of Chemistry). 1987. 12p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Chemical Society, Faraday Translation 2, Vol. 83, No. 8, 1555-1565(1987).

The HE I photoelectron spectra of NbO and TaO have been recorded. In both cases, four main bands were observed that can be attributed to ionization of the isolated metal monoxide molecule. Bands associated with other oxides or the metal were not observed. Assignment of the photoelectron spectra of NbO and TaO was made with the aid of Hartree-Fock-Slater (HFS) calculations and by comparison with the known photoelectron spectrum of VO. The first adiabatic ionization energies of NbO and TaO were measured as 7.91 + or - 0.2 eV and 8.61 + or - 0.02 eV, respectively. Suggestions are made to explain the poor agreement between previous mass-spectrometric values for the first ionization energy of each oxide.

36837 **(AD-A—190100/8/XAB) Fluoride glasses from sol gels. Final report.** Uhlmann, D.R. (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Sep 1986. 7p. NTIS, PC A02/MF A01.

Availability: Document partially illegible.

The use of sol-gel coatings to strengthen oxide glasses was demonstrated for the case of fused silica. Increases in strength to as much as 2.2 times the strength of uncoated glass were obtained. The strengthening does not involve the annealing of surface microcracks, but rather the filling-in of such flaws. The strengthening does not depend on coating thickness over the range 2000-10000 Angstroms, but does depend significantly upon the state of hydrolysis of the substrate surface.

36838 **(AD-A—190259/2/XAB) High-temperature superconductivity. Final report.** Osofsky, M. (Naval Research Lab., Washington, DC (USA)). 14 Dec 1987. 18p. NTIS, PC A03/MF A01.

After the initial discovery of superconductivity over 30K in the La_2-XBaXCuO$_4$ system several groups confirmed the result both resistively and magnetically (flux expulsion). Ultimately, transitions were observed in the analagous compounds with Ba replaced with Ca7 and Sr7,8 for $0.1 \leqq x \leqq 0.3$ with the highest Tc's above 40K. The author's samples were prepared from reagent-grade powders of La_2O_3, $BaCO_3$, $SrCO_3$, $CaCO_3$, PbO_2, and CuO. The powders were mixed in inappropriate ratios and calcined in air between 1000 and 1100C for 12 hours. The resulting materials were reground, pressed into small disks (nominally 1 cm diameter by 2 mm height) and sintered in air at 1000-1100C for 12h. The calcined powders and sintered pellets were x-rayed following each process to ensure that the proper phase was present.

36839 **(AD-A—190340/0/XAB) Temperature-dependent conductivity of oxygen-depleted YBaCuO ceramics. Technical report.** Miller, J.H.; Liu, B.; Riley, W.J.; DiBianca, A.N.; Holder, S.L. (North Carolina Univ., Chapel Hill (USA). Dept. of Chemistry). 9 Jan 1988. 11p. (TR—29). NTIS, PC A03/MF A01.

The electrical conductivity of the oxygen-depleted material YBa$_2$Cu$_3$O/sub 6.4/ was determined as a function of temperature. The conductance is more accurately described as variable range hopping between localized states than as activated conductivity characteristic of a semiconductor.

36840 **(AD-A—190712/0/XAB) Strength and microstructure of ceramics. Annual report, 1 October 1986-30 September 1987.** Lawn, B.R.; Swanson, P.L.; Fairbanks, C.J.; Hockey, B.J.; Mai, Y.W. (National Bureau of Standards, Washington, DC (USA). Ceramics Div.). Nov 1987. 38p. NTIS, PC A03/MF A01.

The goal in this program continues to be the understanding of the role of microstructure in the strength properties of ceramics. It is becoming increasingly apparent to the brittle-fracture community that the toughness characteristics and flaw distributions of structural ceramics can be very much influenced, sometimes with great sensitivity, by small details in the microstructural makeup. For instance, the addition of less than 1% glassy phase to the grain boundaries of alumina polycrystals can alter the fracture properties dramatically, giving rise to significant improvements in strength.

36841 **(AD-A—190713/8/XAB) Magnetic anomalies in the rare earth oxide superconductors GdBa$_2$Cu$_3$O/sub 7-x/ and YBa$_2$Cu$_3$O/sub 7-x/. Technical report.** Hatfield, W.E.; Rohrs, B.R.; Kirk, M.L.; Helms, J.H.; Ro, H. (North Carolina Univ., Chapel Hill (USA). Dept. of Chemistry). 9 Jan 1988. 12p. (TR—3). NTIS, PC A03/MF A01.

The magnetic properties of GdBa$_2$Cu$_3$O/sub 7-X/ and YBa$_2$Cu$_3$O/sub 7-X/ were studied in low applied magnetic field by using pelleted sample. The magnetic behavior may be explained by the occurrence of a spin-glass state due to a granular superconductor. The model assumes superconducting grains which are small compared to the penetration depth, and these are coupled into closed loops. Cooling in zero-field, followed by the application of a field at a fixed temperature produces a metastable state resulting in frustration and spin-glass behavior.

36842 **(AERE-G—4651) Preparation of neptunium oxide spheres for use in neutron dosimetry.** (UKAEA Harwell Lab. Chemistry Div.). Feb 1988. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753981/JAW.

Dense spheres of neptunium oxide have been prepared, by a gel precipitation process, for use in neutron dosimetry. The spheres were of 500 and 800 μm diameter.

36843 **(AERE-R—11773) Transient gas release from irradiated UO$_2$: specimen characterisation and experimental methods.** Small, G.J. (UKAEA Harwell Lab. Materials Development Div.). Nov 1987. 39p. H.M. Stationery Office, London, price Pound 5.00.

A programme of experiments is underway to investigate the release of ^{85}Kr gas from thermal reactor fuel during post-irradiation annealing. In the first series of tests specimens were sealed in small capsules and the integrated release was determined after the anneal by puncturing. Subsequent experiments have been carried out with helium flowing over the specimens continuously, allowing the release of ^{85}Kr to be monitored on-line. The report outlines the origin of the samples and describes various techniques and items of equipment developed specifically for the programme. A comprehensive programme of post-test examination has been devised to extract as much information as possible on the distribution of retained gases between inter-granular bubbles, intra-granular bubbles and solution in the matrix.

36844 (BNL—40954) High temperature zirconium carbide coatings for use in particle bed reactors. Horn, F.L.; Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 19p. (CONF-880488—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007973/JAW.

From 15. international conference on metallurgical coatings; San Diego, CA, USA (11 Apr 1988).

The Particle Bed Reactor is composed of one-half millimeter in diameter nuclear fuel particles held in a fixed bed configuration by frits and cooled by a gas flowing through the bed and frits. The operating temperature of the reactor is in the 1500 to 3000{degree}K range depending upon its projected use. The gas coolant may be an inert gas for closed cycle systems, hydrogen, or decomposed ammonia for open cycle propulsion systems. The high temperature ~2500{degree}K hydrogen system requires a coating on the frits and fuel particles that will not react with hydrogen. Zirconium carbide particles (1/2 mm) were tested at 2000{degree}K in flowing hydrogen gas for twelve hours with little or no reaction (<0.1% weight loss). They also showed no visible surface change under the microscope. Test fuel is being coated with zirconium carbide by the zirconium chloride vapor reaction process. Test frits made by the carbon fiber-carbon composite method have been made and will be coated with zirconium carbide and incorporated in the full-sized fuel element. 5 refs., 12 figs.

36845 (BNL—41304) Modification of YBa_2Cu_3O/sub 7-x/ ceramics by adsorbed water and other gases. Ruckman, M.W.; Chen, D.H.; Moodenbaugh, A.R.; Heald, S.M.; Qiu, S.L.; Lin, C.L.; Strongin, M.; Nichols, D.; Crow, J.E. (Brookhaven National Lab., Upton, NY (USA); Temple Univ., Philadelphia, PA (USA). Dept. of Physics). 1988. Contract AC02-76CH00016. 13p. (CONF-880519—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011518/JAW.

From 4. northeast regional meeting on processing and applications of high {Tc} superconductors; New Brunswick, NJ, USA (9 May 1988).

Surface modification of vacuum scraped YBa_2Cu_3O/sub 7-x/ (x=0,1) by H_2O, CO, CO_2 and O_2 was studied using photoemission and the modification of bulk $YBa_2Cu_3O_7$ and YBa_2}Cu_3O/sub 6.25/ by liquid water was studied using x-ray absorption. Photoemission measurements show that H_2O reacts with the surface by dissociating to form a surface hydroxide. CO and Co_2 form surface compounds that may be carbonates. Molecular oxygen dissociates and readily enters the bulk after adsorption on oxygen-deficient material. The x-ray diffraction and absorption studies show that H_2O readily reacts with oxygen deficient material and completely disrupts it. $BaCO_3$ and a CuO-like phase are detected. $YBa_2Cu_3O_7$ is more stable and was not disrupted. Modifiction of the Cu K-edge and EXAFS resemble those seen when the material reacts with H_2 and this suggests that hydrogen may be produced during the surface reaction with water and may react with the bulk material. 34 refs., 8 figs.

36846 (CEA-CONF—8980) Reactive magnetron sputtering of titanium nitride: analysis of the deposition process. Danroc, J.; Aubert, A.; Gillet, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). Mar 1987. 8p. (CEA-DMG—10-87; CONF-8703154—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752555/JAW.

From International symposium on trends and new applications in thin films; Strasbourg, France (16 Mar 1987).

Pumping rate and gas inlet position are important parameters for elaboration of thin films of zirconium and titanium nitrides. It is observed generally that when partial pressure of nitrogen increases progressively in the plasma, total pressure increases abruptly in the enclosure. This phenomenon reversible with hysteresis, due rapid nitride formation on the target should be weaken for a better operation. It can be obtained by positioning the nitrogen inlet near the pumping system and/or in increasing pumping rate.

36847 (CEGB-TPRD/B—0957/R87) Surface analysis using X-ray photoelectron spectroscopy and X-ray diffraction of UO_2 fuel pellets oxidised in air at 230°C and 270°C. Tempest, P.A.; Tyler, J.W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1987. 41p. (BPC/P—87-248-Rev.). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753604/JAW.

Factors which affect the UO_2 -> U_3O_8 transformation have been investigated by sequentially oxidising UO_2 fuel pellets in air at 230°C and 270°C and monitoring the growth of U_3O_7 and U_3O_8 using X-ray photoelectron spectroscopy, X-ray diffraction and scanning electron microscopy. Initially oxidation proceeded at a linear rate by the inward diffusion of oxygen to form a complete layer of sub-stoichiometric U_3O_7. This phase was tetragonal with a ca ratio of 1.015, significantly less than the value of 1.03 measured on UO_2 powder when oxidised under identical conditions. This difference and the preferred orientation exhibited by surface grains were caused by growth stresses induced in the pellet surface. Both intergranular and transgranular cracking occurred and became nucleation sites for the growth of U_3O_8. The linear oxidation period associated with U_3O_7 growth was much shorter at 270°C than 230°C and U_3O_8 nucleated earlier. Spallation and the production of particulate were only observed during the formation of U_3O_8 when a 30% increase in volume arose from the U_3O_7 -> U_3O_8 phase change.

36848 (CONF-870843—11) The polymorphic transformations of zirconia. Chan, S.K. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009985/JAW.

From International conference on electronic structure in phase stability in advanced ceramics; Argonne, IL, USA (17 Aug 1987).

The polymorphic transformations of zirconia are elucidates as displacive transformations originating from the softening or partial softening of appropriate elastic constants. From expansions of the free energy in powers of symmetry-adapted homogeneous strains, all the possible symmetry and thermodynamically allowed tranformation paths staring from the cubic and tetragonal parent phases are obtained. It is found that transformations that start from the cubic parent phase involve cubic variants and are necessarily of a discontinuous (first order) nature because of symmetry. However, transformations that start from the tetragonal parent phase do not involve cubic invariants. They can be of a discontinuous or continuous (higher than first order) nature depending on whether the fourth order invariants are negative or positive. 18 refs., 2 tabs.

36849 (CONF-880118—5) Interface modification in Nicalon/SiC composites. Lowden, R.A.; Stinton, D.P. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009708/JAW.

From 12. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (20 Jan 1988).

Improved mechanical behavior in Nicalon/SiC composites has been produced by controlling the interfacial bond through coating of the fibers with thin films before densification. Varying degrees of bonding have been achieved with different coating materials and film thicknesses. The effects of bonding on fiber pull-out, and thus mechanical behavior, have been investigated. Fiber-matrix bond strengths have been semi-quantitatively evaluated using indentation methods and a simple tensile test. Electron microscopy and surface analysis were utilized to characterize interface compositions and structures. These results have been used to further examine fiber-matrix interfaces and their influence on mechanical behavior. 37 refs., 9 figs., 1 tab.

36850 (CONF-880118—6) Application of magnification xeroradiography to advanced ceramics. Kriz, R.J.; Ellingson, W.A. (Illinois Univ., Chicago (USA). Dept. of Radiology; Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 19p. (CONF-880118—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009965/JAW.

From 12. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (20 Jan 1988).

Low-density inclusions and voids in ceramics present a detection problem to X-ray imaging because of the relatively low contrast in the resulting image. An X-ray imaging technique called xeroradiography has been in use for medical applications for detecting calcifications (low-density inclusions) in breast tissue. The method has a {open+-quotes}built-in{close+-quotes} edge enhancement. We have applied this technique to green and densified Si_3N_4 specimens and have shown initial improvements over other X-ray methods in detection of seeded defects. 7 refs., 5 figs., 1 tab.

36851 (CONF-880182—1) Ceramic processing of high-T/ sub c/ superconductors. Poeppel, R.B.; Singh, J.P.; Lanagan, M.T.; Goretta, K.C.; Dusek, J.T.; Capone, D.W. II. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. NTIS, PC A02;3. Order Number DE88010090/JAW.

From SPIE conference on superconducting materials and instruments; Los Angeles, CA, USA (10 Jan 1988).

The means by which superconducting YBa_2Cu_3O/sub 7{minus/x} powders can be synthesized are summarized. Methods of forming powders into useful shapes are then described. Lastly, heat treatment schedules used for consolidation of the powders into dense, sound bodies with good superconducting properties are discussed. 19 refs.

36852 (CONF-880206—12) The superconducting transition in oxygen deficient YBa_2Cu_3O/sub 7-δ/. Claus, H.; Crabtree, G.W.; Kwok, W.K.; Veal, B.W. (Illinois Univ., Chicago (USA). Dept. of Physics; Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 2p. (CONF-880206—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009957/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

In this paper we compare the superconductive transition of several oxygen deficient samples measured inductively to that measured resistively and point out important systematic differences between the results of the two types of measurements. Fully oxygenated samples were prepared. The oxygen stoichiometry was reduced by heat treatment at 500{degre}C for 22 hours in an O_2Ar mixture containing various amounts of O_2 flowing over the sample. Samples were then quenched in liquid nitrogen to prevent any change in the oxygen stoichiometry upon cooling. The oxygen content of the samples was determined by weighing. Superconducting transition temperatures were determined by magnetic shielding measurements in a low field SQUID magnetometer in fields of 2 Gauss. The measurements were carried out by cooling the sample to 4.2 K in zero field, applying the measuring field and taking data on warming. Resistivity measurements were made by the four probe ac technique at frequency of 100 Hz and with a measuring current of 1.5mA. 2 refs., 3 figs.

36853 (CONF-880207—2) Superconducting properties of oxygen deficient YBa_2Cu_3O/sub 7-δ/. Kwok, W.K.; Crabtree, C.W.; Veal, B.W.; Claus, H. (Argonne National Lab., IL (USA); Illinois Univ., Chicago (USA). Dept. of Physics). Feb 1988. Contract W-31109-ENG-38. 7p. (CONF-880207—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009969/JAW.

From Discussion meeting on high-{Tc} superconductors; Mauterndorf, Austria (7 Feb 1988).

An important and interesting feature of the high temperature superconductor YBa_2Cu_3O/sub 7{minus/δ} is the dramatic effect of oxygen vacancies on its superconducting properties. As oxygen is systematically removed from the structure, the orthorhombic distortion decreases and the system undergoes a structural transition to a tetragonal phase. Simultaneously, T/sub c/ falls monotonically, with superconductivity disappearing at approximately the stoichiometry where the orthorhombic-to-tetragonal structural transition occurs. The curve of T/sub c/ versus δ shows two regions of stable superconductivity where T/sub c/ is not a strong function of δ. For δ near zero, there is a nearly flat region where T/sub c/ is close to 90{degree}K and for .35 < δ <.45 there is a plateau where T/sub c/ remains constant at approximately 60{degree}K. The width of the inductive transition in these two regions is narrow suggesting that the superconductivity is due to a homogeneous well defined phase. In order to investigate the mechanisms and properties of superconductivity in YBa_2Cu_3O/sub 7{minus/δ} it is necessary to characterize and compare the superconducting behavior in these two phases. In this paper we present resistivity and magnetization data from which we determine the upper critical field H/sub c2/ and compare the relative pinning strengths of polycrystalline samples with δ = 0.04 and 0.4. 18 refs., 4 figs.

36854 (CONF-880207—3) Anisotropy of the lower critical field in YBa_2Cu_3O/sub 7 {minus/δ}. Umezawa, A.; Crabtree, G.W.; Liu, J.Z.; Nunez, L.H. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009971/JAW.

From Discussion meeting on high-{Tc} superconductors; Mauterndorf, Austria (7 Feb 1988).

We report the first careful measurements of the two dimensional anisotropy of the lower critical field H/sub c1/. We compare the anisotropy in our values of H/sub c1/ with the anisotropy observed in H/sub c2/ and derive values for the anisotropy of the effective mass. The single crystals used in this study were grown by a solid state annealing method. Y_2O_3, $BaCO_3$, and CuO powders were mixed in the stoichiometric 1:2:3 ratio, ground with a mortar and pestle, placed in a platinum crucible and heated to 975{degree}C for 3–5 days. The reaction product contained many small crystals up to typical dimensions of 0.5 mm. The crystals showed a sharp inductive onset at 91.5{degree}K as measured in a dc shielding experiment in a field of 10 Oe. In general the crystals were not oxygen annealed before measurement. Three crystals were selected for measurements of H/sub c1/. One of the crystals was used as-grown, one was annealed for 24 hours at 500{degree}C in a pure oxygen environment, and one was irradiated with neutrons to a fluence of 8.16 {times} 10^{17} neutronscm^2. Results are discussed. 10 refs., 4 figs., 1 tab.

36855 (CONF-880207—4) Effect of neutron irradiation on critical magnetization current in single crystal YBa_2Cu_3O/sub 7-δ/. Weber, H.W.; Crabtree, G.W.; Umezawa, A.; Liu, J.Z.; Nunez, L.H. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009970/JAW.

From Discussion meeting on high-{Tc} superconductors; Mauterndorf, Austria (7 Feb 1988).

We have found that critical magnetization currents can be increased through irradiation with fast neutrons. Radiation fluences of up to 8.16 {times} 10_{17} ncm/sup {minus/2} give critical magnetization current enhancements of up to 280% at 77{degree}K. The critical current enhancement at 77{degree}K is greater than that at 45{degree}K at all fields. Above 45{degree}K both the irradiated sample and the unirradiated sample show fairly low anisotropy in their flux pinning, less than a factor of eight. The dependence of the superconducting transition temperature with neutron fluence was found to be {minus}2.6 $K10^{18}$ ncm/sup {minus/2} implying that higher fluences can be used to study the effect of defects on the critical magnetization currents in single crystals. 11 refs., 3 figs., 1 tab.

36856 (CONF-880207—6) Pure metallic bridge and point-contact tunneling into single- and polycrystal YBa_2Cu_3O/sub 7-y/. Gray, K.E.; Moog, E.R.; Hawley, M.E. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010030/JAW.

From Discussion meeting on high-{Tc} superconductors; Mauterndorf, Austria (7 Feb 1988).

It is known theoretically and experimentally that when the resistance of a point-contact is decreased the current-voltage characteristic, I(V), changes from that of an insulating barrier to that of a pure metallic bridge. Such an I(V) still shows the energy gap but, because of its much lower resistance, it is less sensitive to extraneous conduction mechanisms. Values of between 25 and 35 MeV are reported here for YBa_2Cu_3O/sub 7-y/, and these are in agreement with our results for low-resistance point-contact tunneling in both single- and poly-crystal samples. Examples of I(V) and the conduct-

ance, dIdV, will also be presented for pure metallic bridges as well as higher resistance point-contact tunneling. An electrically insulating layer is found on the surface of all samples, including single-crystals showing no evidence of impurities measured by Raman scattering. Consequently, contact of the tunneling tip is necessary to mechanically scrape, and thus clean, the surface before a measurable current can be obtained. Although this represents a disadvantage, a more serious drawback of point-contact tunneling is the inability to measure the I(V) continuously through the transition temperature, T/sub c/, due to thermal expansion of the mechanical apparatus. We will argue that thin film tunnel junctions are thus desirable both to unambiguously identify the energy gap with the 90{degree}K bulk material, and to subtract the background conductance to evaluate the electron coupling mechanism in the high-T/sub c/ superconductors(HTS), that is analogous to electron-phonon coupling in traditional superconductors. 17 refs., 2 figs.

36857 **(CONF-880210—2) Fabrication of bulk superconducting ceramics.** Goretta, K.C.; Dusek, J.T.; Singh, J.P.; Lanagan, M.T.; Balachandran, U.; Dorris, S.E.; Poeppel, R.B. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009956/JAW.

From 1. world congress on superconductivity; Houston, TX, USA (22 Feb 1988).

Mixtures of ceramic powders and plastics can be formed into a variety of useful shapes, which for superconductors are most commonly tapes or wires. Procedures for processing monolithic ceramic superconductors and composite superconductors are described, and factors limiting the properties of these conductors and possible means of enhancing the properties are discussed. 20 refs., 3 figs.

36858 **(CONF-880317—2) Study of the friction and wear-related properties of ceramic superconductors.** Blau, P.J.; DeVore, C.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011844/JAW.

From ASM symposium on engineered materials for advanced friction and applications; Gaithersburg, MD, USA (1 Mar 1988).

The recent interest in high critical temperature (T/sub c/) superconductors has created a need to examine the tribological properties of these materials for defining potential applications and handling characteristics. This paper discusses preliminary information about the reciprocating sliding friction coefficients (self-mated and on gold), scratch resistance, microindentation hardness, and surface damage mechanisms in Y-Ba-Cu-O compounds. These compounds are fabricated in several ways including traditional powder compaction and solution-growing of single crystals. As expected, the materials are quite brittle, but Knoop microindentation hardness numbers for single crystals can exceed 4.41 GPa (450 kg/mm^2). Scratch resistance using a diamond-stylus test decreases with increasing load because intergranular and transgranular cracking increases with load. Friction coefficients on gold range from 0.12 to 1.0, depending on test duration, and those for self-mated sliding range between 0.15 and 1.1, also depending on test duration. Results suggest that the materials are brittle in their monolithic form, but that they show some ability to resist abrasion and sliding wear in a controlled environment.

36859 **(CONF-880408—22) Preparation of superconducting YBa_2Cu_3O/sub 7-x/ films by magnetron sputtering.** Kang, J.H.; Kampwirth, R.T.; Gray, K.E.; Wagner, A.; Huff, E.A. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 3p. (CONF-880408—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009977/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

We have prepared thin films of YBa_2Cu_3O/sub 7-x/ by dc-magnetron sputtering from three separate metallic targets onto ambient temperature substrates of (100)$SrTiO_3$, (100) and random oriented ZrO_2-9%Y_2O_3, and (100)MgO. After annealing, the films grown on $SrTiO_3$ showed a mixture of a- and c- axis orientation while the films grown on ZrO_2 and on MgO were randomly oriented. The targets used in sputtering were either yttrium, barium and copper or yttrium, Ba_3Cu_5 and copper. The latter combination offered better control of the film composition because the CuBa ratio could be more accurately maintained and the target itself was more stable. To check the reproducibility of film composition, an Inductively Coupled Plasma --Atomic Emission Spectroscopy (ICP-AES) technique was employed to obtain average composition. Compositional variations in films produced under similar conditions are within 1--3% which was close to the instrumental resolution. 2 figs.

36860 **(CONF-880466—6) High-power rf applications of high-T/sub c/ superconductors.** Delayen, J.R.; Lanagan, M.T. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012055/JAW.

From Conference on superconductivity and applications; Buffalo, NY, USA (18 Apr 1988).

The rf surface resistance of YBa_2Cu_3O/sub 7-x/ was measured by a half-wave resonant coaxial line technique for bulk ceramic and thick film samples. The surface resistance was found to be dependent upon frequency, temperature, and rf field level. A comparison between design criteria for high power cavities and measured properties was carried out to determine the utility of the YBa_2Cu_3O/sub 7-x/ superconductor.

36861 **(CONF-880466—7) Ceramic fabrication technology for high-T/sub c/ materials.** Lanagan, M.T.; Goretta, K.C.; Singh, J.P.; Goudey, G.T.; Dusek, J.T.; Dos Santos, D.I.; Poeppel, R.B. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012060/JAW.

From Conference on superconductivity and applications; Buffalo, NY, USA (18 Apr 1988).

Three basic processes are discussed for the fabrication of high T/sub c/ superconductors. Superconducting wires of YBa_2Cu_3O/sub 7-x/ are fabricated by extrusion. Tape casting and thick film technology are utilized for the manufacture of YBa_2Cu_3O/sub 7-x/ and silver composite structures. Grain orientation is observed for extruded and tape cast specimens, which is attributed to high shear stresses during plastic forming.

36862 **(CONF-880488—5) Characterization of coating wear phenomena in nitride and carbide coated tool inserts.** Fenske, G.R.; Kaufherr, N.; Lee, R.H.; Kramer, B.M.; Bunshah, R.F.; Sproul, W.D. (Argonne National Lab., IL (USA); George Washington Univ., Washington, DC (USA); California Univ., Los Angeles (USA); Northwestern Univ., Evanston, IL (USA)). 1988. Contract W-31109-ENG-38. 14p. (CONF-880488—). NTIS, PC A03;3. Order Number DE88011196/JAW.

From 15. international conference on metallurgical coatings; San Diego, CA, USA (11 Apr 1988).

Hard nitride- and carbide- coatings of Ti, Zr, and Hf were deposited on T-15 cutting tool inserts using high-rate reactive sputtering (HRRS) and activated reactive evaporation (ARE) processes. The coated inserts were subjected to a series of metal cutting tests to evaluate their performance and to compare their relative ranking with wear model predictions. The cutting tests indicated the coated inserts outperformed uncoated inserts by a factor of 2- to 10 depending on the coating process and composition; however their ranking based on measured lifetime (to reach a 0.003 in. crater depth) did not agree with predicted wear model predictions. Subsequently, a series of short-term cutting tests were initiated to study the wear behavior of the coatings during the early stages of the wear process when the coating was still intact. Post-test examination of the inserts suggest that the predominant wear mechanism was not due to abrasion or thermochemical dissolution as predicted by the model, but was a result of substrate softening followed by microfracture of the coating. The substrate softening is attributed to the severe cutting conditions (325 sfpm under dry cutting conditions) used in the cutting tests. 12 refs., 5 figs., 1 tab.

36863 **(CONF-880504—2) Phase transformations and thermodynamic behavior of the YBa_2Cu_3O/sub x/ system via EMF measurements.** Tetenbaum, M.; Brown, A.; Blander, M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010054/JAW.

From 90. annual meeting of American Ceramic Society; Cincinnati, OH, USA (1 May 1988).

EMF measurements of oxygen fugacities as a function of stoichiometry in YBa_2Cu_3O/sub x/ were made in the temperature range 650-750{degree}C by means of an oxygen titration technique with a ZrO_2 electrolyte doped with Y_2O_3. From plots of equilibrium oxygen pressures versus x, no sign of a change in curvature or discontinuity was observed at an oxygen stoichiometry of x = 6.5 where copper is divalent. A change in slope was observed when x {approximately}6.3. The EMF measurements were extended to an oxygen stoichiometry of x = 6.15; after slow cooling to room temperature, x-ray examination of the samples indicated that the original orthorhombic phase was completely transformed to tetragonal. A rapid increase in the partial molar entropy of oxygen, Δ{ovr S}/sub O{sub 2/}, was found in the composition range x = 6.3 to 6.15. The increase in Δ{ovr S}/sub O{sub 2/} values appears to reflect the differences between distributions of oxygen atoms and vacancies in the relatively disordered tetragonal structure and the more ordered orthorhombic structure. The results to date indicate that the important orthorhombic structure can exist over an extended oxygen composition range, namely, {approximately}6.3-7.0 at temperatures in the range of 650-750{degree}C. 10 refs., 5 figs., 1 tab.

36864 **(CONF-880504—3) Superconducting properties of $LaBa_2Cu_3O$/sub x/ and YBa_2Cu_3O/sub y/.** Balachandran, U.; Goretta, K.C.; Shi, D.; Poeppel, R.B.; Eror, N.G. (Argonne National Lab., IL (USA); Oregon Graduate Center, Beaverton (USA)). Apr 1988. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012038/JAW.

From 90. annual meeting of American Ceramic Society; Cincinnati, OH, USA (1 May 1988).

The liquid-mix technique has been used to synthesize powders of $LaBa_2Cu_3O$/sub x/ and YBa_2Cu_3O/sub y/. The powders were then pressed into pellets and sintered. After annealing in oxygen, specimens from both materials exhibited sharp drops in resistivity at 90K. The Y-based material reached zero resistivity at about 86 K, regardless of the cooling rate from the sintering temperature. The La-based material required rapid cooling and relatively short anneals to achieve onset of superconducting at 90 K, but zero resistivity was not obtained above 77 K.

36865 **(CONF-880724—19) An investigation of ceramic coatings for protection of SiC from high-temperature corrosion.** Federer, J.I. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011023/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

Silicon carbide ceramics are susceptible to corrosion by certain industrial furnace environments. This behavior would limit the use of SiC components in ceramic heat exchangers. Because oxide ceramics corrode substantially less in the same environments, ceramic coatings have been investigated for corrosion protection. Coatings with Al_2O_3, SiO_2, or ZrO_2 as the main constituent were applied to sintered alpha and recrystallized (CS101) SiC substrates. The coated specimens were thermally cycled between room temperature and 1200{degree}C as a test of adherence. Some coatings adhered better to the inherently rougher CS101 SiC; however, most coatings did not adhere to either substrate. Two Al_2O_3-based coatings contained cracks, but remained intact during thermal cycling, and two ZrO_2-based coatings were subjected to corrosion testing at 1200{degree}C in an oxidizing atmosphere containing Na_2CO_3. None of these four coatings exhibited the desired corrosion resistance in this test. Coated samples, however, corroded less than an uncoated sample, indicating that coatings can improve corrosion resistance.

36866 **(CONF-8706300—1) Magnetic studies of a 1-2-3 (Y,Gd)-Ba-Cu-oxide superconductor.** Collings, E.W.; Melling, P.J.; Swartz, S.L.; Smith, R.D.; Rayment, J.J.; Pechan, M.J.; Pardavi-Horvath, M. (Battelle Memorial Inst., Columbus, OH (USA); Miami Univ., Oxford, OH (USA); Ohio State Univ., Columbus (USA)). 1987. Contract FG02-86ER45281. 6p. (CONF-8706300—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010532/JAW.

From 7. international cryogenic materials conference; St. Charles, IL, USA (14 Jun 1987).

Magnetic susceptibility measurements have been conducted on a sample of the ceramic superconductor (Y/sub 0.5/Gd/sub 0.5/)$_1Ba_2Cu_3O$/sub y/ (YGBC, T/sub c/ = 92 K), the related compounds (Y/sub 0.5/La/sub 0.5/)$_1Ba_2Cu_3O$/sub y/ (YLBC) and $Y_1Ba_2Cu_3O$/sub y/ (YBC), and the starting oxides Y_2O_3, La_2O_3, and CuO. It is deduced that the S = 12 moment exhibited by the antiferromagnetic CuO (T/sub N/ = 560 K) is also present in YBC and YLBC and hence, presumably, in the YGBC. In the latter compound, any moment on the Cu is masked by the Gd's large moment (S = 72) which, according to both the susceptibility results and those of electron spin resonance studies which were also performed on the YGBC material, persists into the superconducting phase. Also reported are the results of vibrating sample magnetometer measurements taken under low-field-cycling conditions (about /sub {+-/ 80 gauss, mostly in the Meissner flux-exclusion regime) within the temperature range 4.2 K to about 87 K.

36867 **(CONF-8805134—1) The use of analytical electron microscopy in the study of ion implanted materials.** Sklad, P.S. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. (CONF-8805134—1). NTIS, PC A02;3. Order Number DE88011386/JAW.

From Ion implantation and plasma assisted processes for industrial applications conference; Atlanta, GA, USA (21 May 1988).

Ion beam techniques are used extensively as a means of altering the surface-controlled properties of metallic, ceramic, and semiconductor materials. In most cases the depth of implantation is limited to one or two micrometers. Determination of the microstructural and compositional changes which occur in regions located within a few hundred nanometers of the surface is essential to the understanding of the mechanisms responsible for the observed property changes. Electron microscopy, particularly analytical electron microscopy (AEM), is ideally suited for this purpose. In addition to standard imaging and diffraction techniques, other AEM techniques which prove valuable are convergent beam electron diffraction (CBED), x-ray energy dispersive spectroscopy (EDS), and electron energy loss spectroscopy (EELS). These techniques allow direct measurement and quantification of the microstructure in terms of solute concentration profiles, second phase formation, lattice damage, crystallinity of the implanted layer, and changes produced by post-implantation annealing. The results of such analyses can be correlated with theoretical models, property measurements, and the results of complementary characterization techniques. A number of examples illustrating the application of AEM to the investigation of ion implanted materials are presented. 28 refs., 9 figs.

36868 **(CONF-8805147—1) Ion implantation and thermal annealing of high-T/sub c/ single crystals of YBa_2Cu_3O/sub x/.** White, C.W.; McCallum, J.C.; Boatner, L.A. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). May 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012201/JAW.

From European Materials Research Society meeting; Strasbourg, France (31 May 1988).

Rutherford backscattering spectrometry (RBS) has been used to study the effects of ion implantation and thermal annealing on single crystals of YBa_2Cu_3O/sub x/. The structural disorder induced by ion implantation results in significant changes in the near-surface composition during subsequent thermal processing. Compositional changes in the near-surface region of the YBa_2Cu_3O/sub x/ single crystals were observed after annealing oxygen- or copper-implanted crystals at temperatures of 500°C or higher in various atmospheres. Unimplanted crystals are not affected by the identical processing conditions. Preliminary results show that sintered poly-

crystalline ceramic YB_2Cu_3O/sub x/ also undergoes compositional changes as a result of ion implantation and thermal annealing.

36869 (CRIE-W—86027) Thermophysical properties of ceramics (1). Development of new measurement apparatus and results of test run for standard test piece. Takahashi, Tsuyoshi; Ishikawa, Hiroshi; Hamamatsu, Teruhide. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1987. 24p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752546/JAW.

An apparatus for measuring a thermal diffusivity, one of the thermophysical properties, of structural ceramics at ultra-high temperature was developed. As for the measurement principle, this apparatus utilizes a step-function heating method, where the thermal diffusivity is measured from the temperature dependence of the flat sample on the both sides, on the step heat flux applied to one side of the sample. For the transient heating, a carbonate laser is used. The measurement temperature range is from room temperature to 2300K. In contrast to a conventional method utilizing the temperature dependence of the unradiated face of the sample, the measurement by this apparatus is highly precise even at high temperatures, because of the less correction for the Fourier heat equation which is attributed to the low radiation heat loss. A novel program was prepared for the measurement, control and data analysis. The use of a multi-functional personal computer permitted the measurement from the step heating to the calculation of the thermal diffusivity to be completed in 5 - 6 minutes. The trial measurement on the tantalum standard sample proved the high abilities of this apparatus. (20 figs, 2 tabs, 7 refs)

36870 (CRN-CPR—87-07) Structural, magnetic and electronic properties of rare earth ternary oxides Li Ln(II) $_2$ Ln(III)O_4. Malki, M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jun 1987. 208p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753942/JAW.

Properties of a new class of rare earth ternary oxides Li Ln(II)$_2$ Ln(III)O_4 where Ln(II) is a divalent metal (Sr, Eu) and Ln(III) a trivalent rare earth (Eu, Gd, Dy, Er and Y). These orthorhombic compounds (type Li Eu_3O_4) allow the study of many magnetic phenomena and their evolution in function of the nature of Ln(II) and Ln(III): diamagnetic ions Sr^{2+}, Y^{3+}; isotrope magnetic ions: Eu^{2+}, Gd^{3+} and anisotrope magnetic ions Dy^{3+}, Er^{3+}. Magnetic and electric properties are obtained by classical techniques and from hyperfine interaction by Moessbauer spectroscopy. The possibility to use several Moessbauer resonance (nuclei Eu 151, Gd 155, Dy 161 and Er 166) completes informations obtained by the macroscopic study.

36871 (DOE/DP/40200—70) Measurement of the thermal conductivity of dielectric thin solid films with a thermal comparator. Amsden, C.A.; Gilman, S.E.; Jacobs, S.D.; Torok, J.S. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Apr 1988. Contract FC08-85DP40200. 5p. (CONF-880434—1). NTIS, PC A02/MF A01; GPO Dep. Order Number TI88008468/JAW.

From 4. topical meeting on optical interference coatings; Tucson, AZ, USA (12 Apr 1988).

Low thermal conductivity has important implications for electric and optical applications, where heat deposited in a thin layer must be dissipated to prevent damage. Models which account for thermal transport in thin film structures may have no predictive value if they employ bulk conductivity data. Most techniques utilized to measure the thermal conductivity of thin solid films are difficult and time consuming. The method we have developed is relatively rapid, nondestructive, and is capable of evaluating the samples in a conventional film on substrate geometry. Our thermal conductivity apparatus consists of a control and readout module, signal processing equipment, and an environmentally isolated sample chamber enclosing a sample stage. The commercial unit was converted into a high precision device by temperature controlling both the samples and the sample stage, and by performing averaging of the output signal. The thermal conductivity values obtained are below those of bulk solids. In addition, the conductivities seem to increase with increasing film thickness. Titania seems to have a higher thermal conductivity when deposited by ion-beam sputtering rather than electron-beam evaporation. Some of the electron-beam films were crazed, indicating high levels of stress. The effect of stress and crazing on thermal conductivity is not readily apparent. 11 refs., 1 fig., 1 tab.

36872 (DOE/ER—45307-1) Grain boundary nonstoichiometry in multicomponent ceramics: Technical progress report. Chiang, Yet-Ming. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jan 1988. Contract FG02-87ER45307. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009888/JAW.

Objectives of this research program are to explore and understand detailed relationships between lattice defect chemistry, grain boundary defect chemistry, and properties of interest in multicomponent, nonstoichometric oxide systems. The model systems of greatest interest have been titanates including $SrTiO_3$ and $BaTiO_3$. We have added to these systems the high T/sub c/ cuprate superconductors, which are also multicomponent, nonstoichiometric solids, and in which grain boundary properties are increasingly seen to be primary limitations to attainment of useful properties (especially critical current). Thus, our present work focusses on both titanate and cuprate systems, and the relationship between grain boundary chemistry and (1) grain growth kinetics; (2) electrical barrier properties; and (3) superconducting properties (in the cuprates). Results and conclusions are summarized as follows: (1) Transitions in the grain growth rate as a function of donor concentration in both $SrTiO_3$ and $BaTiO_3$ involve distinct changes in mechanism. (2) When the lattice defect structure is altered via (i) changes in the AB cation stoichiometry; and (ii) varying donor concentration, there is a first-order effect on the composition and morphology of the second phase. Also, the composition of any second phase changes systematically with the overall donor concentration, and at the same time, the wetting behavior of the second phase changes. (3) At completely solid-state grain boundaries, there exist composition changes which are likely to influence the solute-drag mobility. Also, there are deviations in cation stoichiometry at the grain boundary (the boundary is strongly Ti-rich at high temperature equilibrium). 4 refs.

36873 (DOE/ER/02390—T3) Basic research in crystalline and noncrystalline ceramic systems. Kingery, W.D.; Flemings, M.C. Jr.; Dummer, G.H. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). May 1986. Contract AC02-76ER02390. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011577/JAW.

Grain boundaries need to be studied in ceramics in order to be able to control their properties. Grain boundaries in MgO were found to offer a resistance to electronic mobility as a result of their negative charge, especially for n-type conductivity. Grain boundary ionic conductivity increases at high temperature in oxidizing (but not in reducing) atmospheres. The role of additives in the HT sintering and grain growth of SiC was studied. (DLC)

36874 (DOE/ER/45219—3) Defect characterization of the redox behavior and stability of conducting oxides. Anderson, H.U.; Howard, S.A.; Sparlin, D.M. (Missouri Univ., Rolla (USA)). [1988]. Contract FG02-85ER45219. 35p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010799/JAW.

Goal was to study the interrelationships between electrical conductivity, oxidation-reduction kinetics, defect structure, and composition of n- and p-type binary and ternary transition metal oxides. Experimental part included thermogravimet, x-ray diffraction, thermally stimulated current, oxygen diffusion, optical absorption, transmission electron microscopy, electrical conductivity, and Seeback effect. Systems studied were La-doped $SrTiO_3$, Mg-doped $LaCrO_3$, Mg-doped $LaMnO_3$, Sr-doped $LaMnO_3$, Nb-doped $LaCrO_3$, and Ba_2YCu_3O/sub 7-x/. Results show: 1) that at low oxygen activity donor $LaCrO_3$ is n-type, but becomes p-type as oxidation occurs; 2) the oxidation kinetics of both $LaCrO_3$ and $SrTiO_3$ are dominated by a rapid oxygen uptake followed by a slow uptake which can be attributed to a grain boundary type of process followed by volume diffusion; 3) DLTS and electrode probe measurements suggest that the 0.5eV defect state observed for $SrTiO_3$ is

probally due to the grain boundaries; 4) X-ray diffraction studies have revealed that the degree of cation imperfection in La-doped $SrTiO_3$ is directly related to the lattice strain; 5) Initial results for the Ba_2YCu_3O/sub 7-x/ system suggests that the electrical conductivity, hole mobility and thermoelectric power are more strongly dependent upon oxygen stoichiometry than upon temperature. 56 refs., 6 figs.

36875 (DOE/ER/45259—4) Band electronic structures and crystal packing forces: Progress report, July 1, 1987-February 9, 1988. Whangbo, M.H. (North Carolina State Univ., Raleigh (USA). Dept. of Chemistry). 9 Feb 1988. Contract FG05-86ER45259. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010247/JAW.

Progress has been made in several aspects of our research on organic conducting salts, high temperature inorganic superconductors, and other low-dimensional materials. Band electronic structure study on the new ambient-pressure superconductor $(BEDT\text{-}TTF)_2Cu(NCS)_2$ (T/sub c/ = 10.4{degree}K) revealed that this salt is a two-dimensional metal. The $(BPDT\text{-}TTF)_3(INL_4)_2$ salt consists of BPDT-TTF molecules in two different oxidation states. Band electronic structure calculations on $(2,5\text{-}DM\text{-}DCNQI)_2Cu$ revealed that its metallic character must arise from the presence of copper atom mixed-valence (i.e., Cu/sup {+/}and Cu/sup {2+/}). Band electronic structure calculations were performed to examine the difference between the orthorhombic and tetragonal phases of YBa_2Cu_3O/sub 7-y/. We developed empirical atom-atom potentials that reproduce the crystal structure of binary oxides BaO, CuO, La_2O_3, and Y_2O_3. On the basis of our band electronic and empirical atom-atom potential studies, we proposed that linear electron-hole-electron pairing in Cu/sup {2 +/}--O--Cu/sup {3+/}--O--Cu/sup {2+/} units via concerted breathing-mode vibration is essential for the high-temperature superconductivity in La/sub {2-x/M/sub x/ CuO_4 and YBa_2Cu_3O/sub 7-y/. We also found that our empirical atom-atom potentials provide a reasonable set of ir and Raman frequencies for La/sub 2-x/M/sub x/CuO_4. 22 refs.

36876 (DPST—87-748) A method to fit and calculate P-C-T data of metal hydrides. Heung, L.K. (Savannah River Lab., Aiken, SC (USA)). 16 Oct 1987. Contract AC09-76SR00001. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011672/JAW.

The form of an equation for representing the pressure-composition-temperature (P-C-T) data of metal hydrides was discovered in the literature. I tried it for some of the isotherm data produced here and found it fit the data very well. After the coefficients of the equation have been defined, the equation can be used to interpolate and extrapolate within limits P-C-T equilibrium data, which had previously been done by drawing estimated best-fit isotherms. This equation will be useful for engineering calculations of hydride processes, especially in the α and β transition regions. This memo describes the equation and shows how it can be applied to our hydride systems. 1 ref., 1 fig.

36877 (DPST—88-498) Tritium storage effects on La-Ni-Al alloys: helium, and tritium trapping. Walters, R.T.; Mosley, W.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1988. Contract AC09-76SR00001. 21p. (CONF-8804146—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011666/JAW.

From Storage science meeting; Los Alamos, NM, USA (4 Apr 1988).

The use of La-Ni-Al metal hydrides to process and store tritium presents unique problems to the handling of tritium. All hydrogen isotopes are "trapped" in La-Ni-Al alloys as a function of homogeneity and the degree of activation, or number of full cycles the material experiences before being exposed to tritium. To a lesser extent, the mole fraction of aluminum has an effect on the number of cycles needed for full activation. Data is presented which shows the effect of La-rich second phases on the retentium of protium, the x-ray diffraction line broadening as a function of number of cycles, and the observed "heel" in the alpha region of the isotherm due to Ni-Al second phases. There also appears to be an increase in solubility of tritium due to the lattice expansion on the metal.

36878 (INIS-BR—1018, pp 9) 'In situ' measurement by optical techniques of the thickness of niobium pentoxide anodic films, Nb_2O_5. Juliao, J.F.; Fernandes, C.D.P.; Chagas, J.W.R.; Cesar, H.L.; Decker, F. (Ceara Univ., Fortaleza (Brazil). Dept. de Fisica; Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

36879 (INIS-BR—1018, pp 10) Comparative analysis of some measuring techniques of the thickness of niobium and tantalum oxide anodic films. Holanda, J.N.F. de; Gomes, U.U. (Rio Grande do Norte Univ., Natal (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

36880 (JINR-E—8-87-499) Experimental study of electric field influence on low temperature long-time relaxation in crystalline ferroelectrics. Sahling, S.; Kolac, M.; Sahling, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702913/JAW.

Submitted to the journal J. Low Temp. Phys. .

Calorimetric measurements with polycrystalline Pb/sub 0.915/La/sub 0.085/x(Zr/sub 0.65/Ti/sub 0.35/)O_3 were performed at helium temperatures in electric field E ($0 \leqq E \leqq 4.3$ kVcm). Heat release after cooling from T_1(1.3 K $\leqq T_1 \leqq$ 35 K) to T_0=1.3 K is very similar to that in amorphous metals and dielectrics. Experimental results disagree with the standard tunneling model. The observed release may be explained assuming the existence of a maximum energy is an element of/sub f/ in the distribution function. The maximum relaxation time tau/sub max/ was found as a function of T_1. A similar heat release is observed after switching on or off the electric field. In dependent of T for 1.1 K $\leqq T \leqq$ 3 K, proportional to E^2 with tau/sub max/ $\sim$ E. No heat release was observed in the KH_2PO_4 single crystal. 28 refs.; 7 figs.

36881 (KFK—4306) Preparation and behaviour of wear resistant coatings with a high amount of phase boundaries. Schulz, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Aug 1987. 183p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753373/JAW.

The possibility to increase the toughness of wear-resistant coatings by introducing a high amount of phase boundaries in the coating were examined. Monolayer TiC-, TiN- and TiB_2-coatings, sequential TiC-TiN, TiC-TiB_2- and TiB_2-TiN-coatings with 10, 100, 250 500 and 1000 monolayers and simultaneous TiCTiB_2-coatings were sputtered on cemented carbides. The structure (constitution, structural fracture), the properties (hardness, toughness, residual stresses, adherence) and the wear behaviour at continuous and interrupted cutting conditions were examined. For comparison CVD-coated cemented carbides were also examined. The investigation of the influence of the annealing conditions on the properties and the wear behaviour of simultaneous TiCTiB_2-coatings has not been performed yet. On the sputtered phase boundary of sequential coatings a mixed phase is formed. The width of the mixing phase was evaluated to be 1 nm for TiB_2-TiN-coatings, 2 nm for TiC-TiB_2-coatings and 3-4 n for TiC-TiN-coatings. On the Ti, C, B- and Ti, N, B-mixing phase TiB_2 grows up to 5 and 10 nm in an amorphous state. A strong dependence of the toughness, determined by the crack formation and propagation at Vickers and Hertzian indentations, on the amount of phase transitions was detected for sequential coatings. 5 μm thick coatings with 100 to 250 phase transitions show favourable toughness properties. Those coatings also have a high resistance to flank wear and are superior to sputtered monolayer coatings and to CVD-coatings, especially at interrupted cutting conditions. (orig.IHOE).

36882 (LA-UR—88-642) Electron microscopy of ceramic superconductors. Mitchell, T.E.; Roy, T. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880737—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006446/JAW.

From 4. Asia-Pacific conference on electron microscopy; Bangkok, Thailand (26 Jul 1988).

The critical current Jc is at least as important as Tc (transition temperature) for applications in superconducting materials. Jc is strongly dependent on microstructure and, in consequence, electron microscopy will continue to be important in the development of practical ceramic superconductors. We will review the progress that has been made over the past year or so in studying the superconductors by electron microscopy techniques of all kinds–conventional, high resolution, analytical, etc. A thorough review is impossible but a bibliography is available, as well as two special issues of Journals. 25 refs., 9 figs.

36883 (LBL—23946) High-T/sub c/ superconductor and its use in superconducting magnets. Green, M.A. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 69p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88008403/JAW.

Many of the proposed uses for the high-T/sub c/ superconductor involve the creation of a magnetic field using superconducting coils. This report will assess what is known about the high-T/sub c/ superconductors and take a realistic look at their potential use in various kinds of superconducting magnets. Based on what is known about the high-T/sub c/ superconductors, one can make a "wish list" of things that will make such materials useful for magnets. Then, the following question is asked. If one had a high-T/sub c/ superconductor with the same properties as modern niobium-titanium superconductor, how would the superconductor work in a magnet environment? Finally, this report will show the potential impact of the ideal high-T/sub c/ superconductor on: 1) accelerator dipole and quadrupole magnets, 2) superconducting magnets for use in space, and 3) superconducting solenoids for magnetic resonance imaging. 78 refs., 11 tabs.

36884 (LBL—25010) Application of controlled interfacial pore structures to kinetic studies in alumina. Roedel, J.; Glaeser, A.M. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 8p. (CONF-8804112—4; CONF-8804112—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010884/JAW.

From Interfacial structure, properties and designs in solids; Reno, NV, USA (5 Apr 1988).

The application of controlled-geometry interfacial pore structures to fundamental kinetic studies in alumina is described. Results from studies of the morphological stability of high aspect ratio pore channels, crack healing, pore coarsening and pore elimination in sapphire are presented.

36885 (LBL—25165) Sintering of the heterogeneous MgO compacts. Lin, Mark Kin-Fu. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 109p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010357/JAW.

This study explores the optimum sintering schedule for an agglomerate compact. Various pertinent models have been proposed to assess the influence of the multimodal pore size distributions on the overall densification kinetics and the effect of temperature on the sintered microstructure. A thorough investigation of the sintering behavior and microstructural evolution for the heterogeneous MgO compact has been performed. The enhancements of the densification rate, the grain growth rate, and the increase in interpore spacing while sintering the heterogeneous compacts have been observed in this study. High-temperature sintering tends to produce a heterogeneous structure, and many pores are trapped within the grains. Low-temperature sintering is advantageous to produce a more homogeneous structure. 2-step sintering, combining a pretreatment at low temperature (i.e., the homogenization treatment) with subsequent high temperature sintering, is proposed as an optimum sintering schedule for the agglomerated compact. 97 refs., 37 figs.

36886 (LBL—25340) Stability range of MoC (hP2). II. Thermodynamic properties of generalized Lewis acid-base intermetallics. Kouvetakis, J. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88011941/JAW.

The γ-MoC phase with the hexagonal WC structure was prepared without the presence of metal stabilizers at temperatures below 1000°C. This phase was found to be thermodynamically stable at low temperatures and decomposed to Mo_2C and graphite at 1400 K. Using equilibrium and thermodynamic data, the thermodynamic quantities of this phase were calculated as $S°_{298}/R = 4.41 +/- 0.3$ and $\Delta H_{298}°/R = -3430 +/- 800$ K. Part II. Oxide equilibration and solid-state galvanic cell experiments were used to study thermodynamic properties of binary Lewis acid-base stabilized transition metal alloys. The activity of vanadium was determined in alloys of vanadium with platinum group metals such as Rh, Pd and Ir at 1000°C. The activities of titanium in titanium-iridium alloys and of niobium in Nb_3Ir were determined at 1400°C. The ternary phase diagram of V-Pd-O at 1000°C was obtained. Based on the vanadium-palladium results, a partial titration curve of palladium by vanadium was constructed. The excess partial molar Gibbs free energy of vanadium at infinite dilution was found to be -36.4 kcal mol^{-1} at 1000°C. The results of this study are in agreement with the predictions of Brewer's theory of transition metal alloy acid-base behavior.

36887 (LBL—25347) Structural properties of $YBa_2Cu_3O/sub\ 6+\delta/$. Morris, J.W. Jr.; Khachaturyan, A.G. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 9p. (CONF-880529—). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012028/JAW.

From MRS international meeting on advanced materials; Tokyo, Japan (30 May 1988).

The composition-wave theory of oxide structures is used to interpret the equilibrium structures of $YBa_2Cu_3O/sub\ 6+\delta/$, predict its equilibrium phase diagram, describe the transient ordered states that are most likely to appear during decomposition, and discuss the probable transformation paths and microstructures that follow from them. The results are in reasonable agreement with experiment.

36888 (ORNL/Sub—84-00216/1) Studies of dynamic contact of ceramics and alloys for advanced heat engines: Final report. Dufrane, K.F.; Glaeser, W.A.; Rosenfield, A.R. (Battelle Columbus Div., OH (USA)). Mar 1988. Contract AC05-84OR21400. 95p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88008996/JAW.

In support of the efforts to apply ceramics in advanced heat engines, a study was made of the sliding performance of ceramics at the ring/cylinder interface of low heat rejection engines. The objective was to understand the basic mechanisms controlling the wear of candidate ceramics and thereby identify means for applying these ceramics effectively. Attempts to operate three different zirconias, silicon carbide, silicon nitride, and several plasma-sprayed ceramic coatings without lubrication were unsuccessful because of high friction and high wear rates. Experiments using a polyalphaolefin lubricant at temperatures to 260 C identified several combinations having wear rates in the general range likely to be acceptable for engines. Plasma-sprayed coatings of chromium oxide and hypersonic powder flame sprayed coatings of cobalt-bonded tungsten carbide performed particularly well as ring coatings. Similar performance was obtained with these ring coatings operating against silicon carbide, silicon nitride, silicon carbide whisker-reinforced alumina, and chromium oxide coatings. Zirconia experienced high wear rates because of thermal-shock-induced surface cracking. Low thermal conductivity of zirconia allows local areas to heat excessively from friction. Periodic heating induces thermal shock cracking and subsequent spalling. The study demonstrated the importance of lubrication to successful sliding of ceramics and the need for lubricants capable of operating at temperatures in the range of 250 to 650 C. 42 refs., 32 figs., 8 tabs.

36889 (ORNL/TM—10710) Development of x-ray methods for analyzing rough-wear surfaces on ceramics. Blau, P.J.; Houska, C.R. (Oak Ridge National Lab., TN (USA); Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). May 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010754/JAW.

This report summarizes research performed by Virginia Polytechnic Institute and State University under subcontract to Oak Ridge National Laboratory. The work, funded by the Energy Conversion and Utilization Technologies Program of the US Department of Energy, began January 1, 1983, and ended September 30, 1987. The research has resulted in the successful completion of Bing Hwang's Ph.D. degree in Materials Engineering Science from Virginia Polytechnic Institute and State University. The reference to Dr. Hwang's thesis is Near Surface Wear Structure of Ceramic Components, Virginia Polytechnic Institute and State University, Blacksburg, Va., May 1987. The purpose of the research was to develop novel x-ray diffraction and fluorescence methods for probing the near-surface (<1 μm deep) zone of worn ceramics. An important aspect of the work in regard to fundamental tribology research was to overcome the difficulties associated with x-ray analysis of rough surfaces. Fully and partially stabilized zirconia (PSZ) were selected as the materials to be examined by the x-ray techniques being developed. The specific characteristics of the worn ceramic surface of most interest were phase content, particle size, and near-surface strains. This summary outlines the major findings of this work. Details of the mathematical analysis may be found in the four cited open-literature references. Material in this report has been abstracted from the original manuscripts and reprints of these references. Each reference is separately outlined. 1 ref., 4 figs.

36890 (PB—88-183926/XAB) Research and development of superconductors. Okugawa, M.; Hiraoka, M.; Takada, Y. (Mitsubishi Cable Industries Ltd., Tokyo (Japan)). 1987. 7p. NTIS, PC E05.

Text in Japanese; Included in Mitsubishi Cable Industries, Ltd., No. 74, 1-7(Oct 1987).

This report introduces the research and development of high-temperature superconducting oxides, which have been drawing world-wide attention since last year. The authors review the characteristics and the mechanism of suprconductivity and the present trend of world-wide R&D of high-temperature superconducting oxides. Through the research into practical applications of high-temperature superconducting oxides, superconductivity has been obtained on silver sheathed wire as well. However, it is still necessary to improve critical current density and stability. In addition to these, thin-film processing technologies are investigated.

36891 (PB—88-197165/XAB) Development of protective coatings for ceramic tubular components. Topical report, March 1986-December 1987. van Roode, M.; Price, J.R. (Solar Turbines, Inc., San Diego, CA (USA)). Dec 1987. 101p. (SR—87-R-5334-12). NTIS, PC A06/MF A01.

Process technology was developed for the deposition of adherent ceramic oxide coatings on silicon-based substrates for corrosion protection of ceramic heat-exchanger tubes operating in aluminum remelters. Single- and multi-layer coatings of mullite, zircon, alumina, yttria, and yttria-stabilized zirconia remained adherent and intact after isothermal heat treatment at 1093°C/120 hours followed by cyclic heat treatment between 1010°C and 371°C (60 one hour cycles). Ten optimized coating compositions were deposited on alpha-SiC and SCRB-210 tubes for environmental-exposure testing in a simulated aluminum-remelt environment. An aluminum-reclamation simulator was designed, constructed, and installed under the program. A computer simulation study was undertaken to characterize the gas-phase chemistry in the aluminum remelt environment and to predict the nature of the corrosion products at the silicon-based tube surfaces. Mechanical properties of coated and uncoated tube specimens were determined.

36892 (PNL-SA—15409) Chemical control of stress in sol-gel derived titania films and their pressure dependent optical properties. Frydrych, W.S.; Exarhos, G.J.; Ferris, K.F.; Hess, N.J. (Pacific Northwest Lab., Richland, WA (USA); Washington Univ., Seattle (USA)). Apr 1988. Contract AC06-76RL01830. 7p. (CONF-880408—20; CONF-880408—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009472/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

Optical properties and durability of thin films are influenced by strain which can be evaluated from frequency shifts of the lattice phonon lines in measured Raman spectra. The response of titania samples to applied pressure is reported in this work. Anatase and rutile samples of thin films (sol-gel and sputter deposited) and bulk materials have been subjected to hydrostatic pressures approaching 100 kbar in a diamond anvil cell. Results indicate that the rutile samples exhibit similar responses to applied pressure. Anatase sol-gel films exhibit a pressure-dependent response that suggests that the sol-gel film is more compressible than the bulk material, and a pressure-induced phase transformation observed for the bulk material is inhibited in the anatase sol-gel film. The anomalous pressure response of the anatase sol-gel film may result from the film microstructure which has been shown by transmission electron microscopy to consist of spheres of crystalline TiO_2 surrounded by microscopic voids. 9 refs., 4 figs.

36893 (SAND—87-2724C) An XPS [x-ray photoelectron spectroscopy] study of YBa_2Cu_3O/sub x/ surface corrosion. Brow, R.K. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 19p. (CONF-8805123—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010226/JAW.

From Superconductor symposium; Cincinnati, OH, USA (1 May 1988).

X-ray photoelectron spectroscopy (XPS) was used to characterize changes in the surface composition of dense, polycrystalline samples of hot-pressed and sintered tetragonal and orthorhombic YBa_2Cu_3O/sub x/ exposed to ambient conditions. A detectable surface corrosion film forms in less than one second after vacuum fractured surfaces are exposed to room temperature air. Features in the Ba3d, O1s and C1s spectra indicate that this surface film contains $BaCO_3$. Electron micrographs of the vacuum fractured hot-pressed samples reveal primarily a transgranular fracture path, while the fracture surfaces of sintered samples consisted of primarily exposed, faceted grains. The XPS analyses of these later vacuum fractured samples showed high degrees of $BaCO_3$-contamination, similar to what was found on air-exposed surfaces, indicating that significant grain-boundary contamination was present in these materials. 6 figs., 14 refs.

36894 (SAND—88-1197C) La_2CuO/sub 4+δ/: A superconducting superoxide. Schirber, J.E.; Morosin, B.; Venturini, E.L.; Shinn, N.D.; Rogers, J.W. Jr.; Ginley, D.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-880579—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010325/JAW.

From 10. annual ideas in science and electronics exposition; Albuquerque, NM, USA (10 May 1988).

High pressurehigh temperature oxygen treatment results in changing antiferromagnetic La_2CuO_4 into a bulk superconductor La_2CuO/sub 4.13/. Evidence demonstrating that the excess oxygen is incorporated as the superoxide, is diacharged. 7 refs.

36895 (SAND—88-1467C) Penetration and perforation of reinforced-concrete targets. Forrestal, M.J.; Hightower, M.M.; Luk, V.K.; Christensen, B.K. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 23p. (CONF-8805137—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011483/JAW.

From NATO workshop on penetration; NDRE, Norway (30 May 1988).

The authors developed penetration equations for rigid, ogival nose projectiles that penetrated and perforated reinforced-concrete targets at normal incidence. The closed-form, penetration

equations depend on the impact velocity, geometry and mass of the projectile, and the material properties of the target. Predictions from the models showed good agreement with test data.

36896 **Mechanical and superconducting properties of sintered composite $YBa_2Cu_3O_7$/sub -//sub δ/ tape on a silver substrate.** Singh, J.P.; Shi, D.; Capone D.W. II. (Materials and Components Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* 53: No. 3, 237-239(18 Jul 1988).

Flexible sintered composite YBa_2Cu_3O/sub 7-//sub δ/ tapes on a silver substrate have been fabricated by the tape casting technique followed by appropriate sintering. The sintered composite tape can be bent into an arc of a 27-mm-diam circle without breaking. This represents approximately 2% strain, as compared with a typical YBa_2Cu_3O/sub 7-//sub δ/ superconductor material without silver, which fractures at a strain of ~0.1—0.2%. The silver addition does not adversely affect the superconducting properties of the composite.

36897 **Switching mechanism in V_2O_5 gel films.** Zhang, J.G.; Eklund, P.C. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky, 40506). *Journal of Applied Physics;* 64: No. 2, 729-733(15 Jul 1988).

We report the first explanation of the novel electrical switching in two-terminal devices based on thin $V_2O_5x1.6H_2O$ gel films. The switching is shown to be associated with the existence of a current-induced channel between the contacts. The data demonstrate that the switching between the "on" and "off" states of the device is driven by the joule heating of a metal-insulator (MI) transition in the channel material (or filaments in the channel). Resistivity data on the channel exhibit a sharp MI transition at T = 334 K which is also the temperature at which the device is observed to stop switching. The signature of the MI transition in the channel is very similar to that observed in VO_2(T/sub MI/ = 341 K), suggesting the channel may contain VO_2√/sub x/ conduction paths.

36898 **Electron channeling study of polycrystalline YBa_2Cu_3O/sub x/.** Verhoeven, J.D.; Gibson, E.D.; Chumbley, L.S.; McCallum, R.W.; Baker, H.H. (Ames Laboratory and Department of Material Science and Engineering, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* 64: No. 2, 761-765(15 Jul 1988).

An electron channeling study has been done on large grained YBa_2Cu_3O/sub x/ samples. Selected area channeling patterns (SACP) were used to examine several dozen grains on electropolished surfaces and it was demonstrated that (a) the twin planes observed in polarized optical light microscopy lie parallel to {110} crystal planes, and (b) the long flat sides of high aspect ratio grains are formed by basal planes, and the shorter sides are formed by either (010), (100), or {110} planes. A majority of the large grains examined were found to contain subgrains, misaligned by 0.5°—1° and ranging in size from less than 3 to 20 μm. The origin of the subgrains is not understood.

36899 **Highly oriented superconducting thin films derived from the sol-gel process.** Kramer, S.A.; Kordas, G.; McMillan, J.; Hilton, G.C.; Van Harligen, D.J. (Department of Materials Science and Engineering and Materials Research Laboratory, University of Illinois at Urbana—Champaign, 105 South Goodwin, Urbana, Illinois 61801). *Applied Physics Letters;* 53: No. 2, 156-158(11 Jul 1988).

Highly oriented YBa_2Cu_3O/sub 6+//sub x/ superconducting thin films have been developed via sol-gel processing. Film deposition involved spin coating a "partially hydrolyzed" metal-alkoxide stock solution onto single-crystal [100] $SrTiO_3$ substrates. Although scanning electron microscopy revealed the film consisted of oriented polycrystallites, from the broad statistical x-ray diffraction data the 1000 A film "appeared" to be single crystal with moderate mosaic spread (i.e., full width at half-maximum was 0.3° in θ at a 2θ of 55°). No twinning of the crystal was found in any of the three orthogonal directions (2θ, phi, chi). The onset temperature T/sub c/ for the film was 55 K while the critical current density J/sub c/ was found to be 10^3 A/cm^2.

36900 **60—90 K superconducting phase transition in YBa_2Cu_3O/sub 7-//sub δ/.** Shi, D.; Capone D.W. II. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* 53: No. 2, 159-161(11 Jul 1988).

The kinetic process between the 60 and 90 K superconducting phase transition has been explored to study the oxygen ordering mechanisms. An abrupt change in T/sub c/ from 60 to 90 K is observed as the sample's oxygen content is rapidly varied from around 6.6 to 6.9. No intermediate T/sub c/ values are obtained, which suggests an oxygen ordering instability, leading to a phase transition between the 60 and 90 K superconducting phases.

36901 **Growth kinetics of ZnO prepared by organometallic chemical vapor deposition.** Souletie, P.; Wessels, B.W. (Department of Materials Science and Engineering and Materials Research Center, Northwestern University, Evanston, Illinois 60208). *Journal of Materials Research;* 3: No. 4, 740-744(Jul 1988).

Zinc oxide films were deposited using the reactants dimethyl zinc and tetrahydrofuran. Growth kinetics were determined from the dependence of the growth rate on substrate temperature and reactant partial pressure. A complex temperature dependence was observed over the temperature range of 300—500 °C. For a deposition temperature of 400 °C, the growth kinetics were modeled using a bimolecular surface reaction rate-limited mechanism. The layers were characterized using x-ray diffractometer and Auger spectroscopy measurements.

36902 **Zirconium oxide crystal phase: The role of the pH and time to attain the final pH for precipitation of the hydrous oxide.** Srinivasan, R.; Harris, M.B.; Simpson, S.F.; De Angelis, R.J.; Davis, B.H. (Kentucky Energy Cabinet Laboratory, University of Louisville, P.O. Box 13015, Lexington, Kentucky 40512 and the Department of Metallurgical Engineering and Materials Science, University of Kentucky, Lexington, Kentucky 40506). *Journal of Materials Research;* 3: No. 4, 787-797(Jul 1988).

Precipitated hydrous zirconium oxide can be calcined to produce either a monoclinic or tetragonal product. It has been observed that the time taken to attain the final pH of the solution in contact with the precipitate plays a dominant role in determining the crystal structure of the zirconium oxide after calcination at 500 °C. The dependence of crystal structure on the rate of precipitation is observed only in the pH range 7—11. Rapid precipitation in this pH range yields predominately monoclinic zirconia, whereas slow (8 h) precipitation produces the tetragonal phase. At pH of approximately 13.0, only the tetragonal phase is formed from both slowly and rapidly precipitated hydrous oxide. The present results, together with earlier results, show that both the pH of the supernatant liquid and the time taken to attain this pH play dominant roles in determining the crystal structure of zirconia that is formed after calcination of the hydrous oxide. The factors that determine the crystal phase are therefore imparted in a mechanism of precipitation that depends upon the pH, and it is inferred that it is the hydroxyl concentration that is the dominant factor.

36903 **Nature of the magnetic order of Cu in oxygen-deficient $NdBa_2Cu_3O_6$μ/sub x/.** Lynn, J.W.; Li, W.; Mook, H.A.; Sales, B.C.; Fisk, Z. (Center for Superconductivity Research, Department of Physics, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* 60: No. 26, 2781-2784(27 Jun 1988).

Neutron diffraction measurements have been taken on single crystals of $NdBa_2Cu_3O_6$μ/sub x/ to explore the nature of the magnetic order as a function of oxygen concentration x. The Cu-O planes are known to order antiferromagnetically at T/sub N1/, with T/sub N1/(x≅0)≅450 K. At lower temperatures we find that the oxygen-deficient Cu planes also order magnetically [T/sub N2/(x≅0.1)≅80 K], with a large ordered moment of 0.46μ/sub B/ and a simple antiferromagnetic sequencing along the c axis. Both ordering temperatures decrease with increasing x, with T/sub N2/ being much more sensitive to x than T/sub N1/.

36904 Single-crystal neutron-diffraction study of $La_2Cu_{0.95}Li_{0.05}O_4$. Delgado, J.M.; McMullan, R.K.; Diaz de Delgado, G.; Wuensch, B.J.; Picone, P.J.; Jenssen, H.P.; Gabbe, D.R. (Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9343-9352(1 Jun 1988).

La_2CuO_4 possesses an orthorhombic superstructure based upon a tetragonal K_2NiF_4-type subcell for which a number of different space groups have been reported. A single-crystal neutron diffraction study, performed with large flux-grown crystals, confirms the nature of the substructure and provides a = 5.359(1), b = 5.363(1), and c = 13.127(2) A. The orthorhombic strain, $\epsilon = (b-a)(12(a+b))$, is 7.64 x 10^{-4}, an order of magnitude smaller than for pure La_2CuO_4 as a result of incorporation of Li, derived from the flux, in the Cu site. The apparent space group is Pccn, but systematic examination of structural models in all possible centrosymmetric orthorhombic subgroups which may accomodate a K_2NiF_4-type substructure led to satisfactory refinement with positive-definite temperature factors only in space group Bmab-D_{2h}^{18}. A substantial number of very weak reflections were detected which violate the required systematic absences of this space group. Through structure-factor calculation, after reindexing based on a probable twin law, and through dark-field transmission electron microscopy, the "forbidden" reflections are shown to arise from a 0.302(2) volume fraction of domains in twinned orientation which otherwise escaped detection because of the small value of ϵ. Final agreement indices for 346 reflections with $I \geq \sigma(I)$ are R(F) = 3.22%, $R(F^2)$ = 2.57%, R/sub w/(F_s) = 3.07%; the goodness of fit, S, is 1.13.

36905 Magnetic properties of oxygen-reduced, rare-earth based $R_1Ba_2Cu_3O_7\sqrt{}$/sub x/ compounds with R = Gd, Dy, and Ho. Thompson, J.R.; Sales, B.C.; Kim, Y.C.; Sekula, S.T.; Boatner, L.A.; Brynestad, J.; Christen, D.K. (Solid State Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6061). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9395-9400(1 Jun 1988).

The bulk magnetic properties of tetragonal, oxygen-depleted, polycrystalline samples of sintered $R_1Ba_2Cu_3O_7\sqrt{}$/sub x/ compounds with x = 0.95 have been investigated. Materials containing the rare-earth (RE) ions Gd, Dy, and Ho were studied. In each case, the magnetic susceptibility chi was described by a Curie-Weiss (CW) dependence with effective moments that were very nearly equal to the free-ion values—behavior that is very similar to the superconducting counterparts of these materials where the oxygen has not been depleted. The field dependence of the magnetization M(H,T) was found to be substantially modified by crystalline electric field effects and by the influence of Re-Re interactions.

36906 Muon depolarization and magnetic-field penetration depth in superconducting $GdBa_2Cu_3O$/sub x/. Cooke, D.W.; Hutson, R.L.; Kwok, R.S.; Maez, M.; Rempp, H.; Schillaci, M.E.; Smith, J.L.; Willis, J.O.; Lichti, R.L.; Chan, K.B.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9401-9404(1 Jun 1988).

Positive muon spin-rotation (μSR) measurements on $GdBa_2Cu_3O$/sub x/(x≅7) have been conducted in the temperature interval 5.8—300 K. A temperature-dependent relaxation, attributable to Korringa relaxation of the Gd ion, as well as vortex-state relaxation are observed. Magnetic field penetration depths of approximately 1550 and 1900 A (two samples) are extracted from the data. Two muon stopping sites exist for T≦80 K, one being associated with normal regions of the sample and the other with superconducting regions.

36907 Helium, tritium, and protium NMR studies of tritide-free aged PdT/sub x/. Bowman R.C. Jr.; Bambakidis, G.; Abell, G.C.; Attalla, A.; Craft, B.D. (Monsanto Research Corporation, Mound Facility, Miamisburg, Ohio 45342). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9447-9454(1 Jun 1988).

Pulsed NMR relaxation-time measurements have been performed on PdT/sub x/, aged approximately eight years, after first removing most of the tritium by room-temperature desorption and again after addition of protium to one of these tritide-free samples. Spin-lattice and spin-spin relaxation times T_1 and T_2 were measured for both tritium and ^{3}He in the temperature range 100—300 K, while T_1, T_2, and the rotating-frame relaxation time T_1/sub rho/ were obtained for protium in the same temperature range. The relative magnitudes of T_1, the decay time T_2/sub m/ of the Carr-Purcell-Meiboom-Gill signals, and the line-shape decay time T_2/sup */ for ^{3}He in tritide-free PdT/sub x/, are consistent with the distribution of the helium as microbubbles in the Pd matrix. The increase in the ^{3}He values of T_1 upon addition of protium to an atomic ratio [H][Pd] = 0.68 is attributed partially to a decrease in the Fermi-level density of states and partially to other internal relaxation mechanisms. Analysis of the dipolar component T_1/sub d/ of T_1, for protons in the sample to which protium was added, gives a value of the diffusion activation energy at temperatures between 230 and 300 K which is in agreement with that for β-PdH/sub x/. Comparison with the triton NMR in tritide-free PdT/sub x/ indicates that the residual tritium, rather than forming a dilute solid solution, occupies unusual sites in the Pd lattice, perhaps at internal surfaces surrounding the ^{3}He microbubbles.

36908 Anisotropic thermoelectric power and conductivity in single-crystal YBa_2CuO/sub y/. Crommie, M.F.; Zettl, A.; Barbee T.W. III; Cohen, M.L. (Department of Physics, University of California, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9734-9737(1 Jun 1988).

Thermoelectric power (TEP) and electrical conductivity measurements are reported for different crystal directions and for varying oxygen deficiency in single-crystal YBa_2Cu_3O/sub y/. The dependency of the transport parameters on direction are compared with the predictions of band theory. The c-axis conductivity and TEP are suggestive of non-band-transport as might be displayed by a localized system.

36909 Two-dimensional zone-center spin-wave excitations in La_2CuO_4. Peters, C.J.; Birgeneau, R.J.; Kastner, M.A.; Yoshizawa, H.; Endoh, Y.; Tranquada, J.; Shirane, G.; Hidaka, Y.; Oda, M.; Suzuki, M.; and others. (Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9761-9764(1 Jun 1988).

We have studied the spin-wave excitations near the two-dimensional zone center at 80 K in a single crystal of La_2CuO_4 which orders at T/sub N/ = 195 K. In-plane and out-of-plane modes are observed at energies of 1.0 +- 0.25 meV and 2.5 +- 0.5 meV, respectively. The in-plane mode energy is determined primarily by the antisymmetric exchange and it measures this term directly. The out-of-plane mode energy corresponds to a planar anisotropy energy of ~0.016 meV. We observe, in addition, the appearance of significant E≅0 scattering below 30 K.

36910 Symmetry breaking and nonlinear electrodynamics in the ceramic superconductor $YBa_2Cu_3O_7$. Jeffries, C.; Lam, Q.H.; Kim, Y.; Bourne, L.C.; Zettl, A. (Physics Department, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9840-9843(1 Jun 1988).

For bulk samples of the ceramic superconductor $YBa_2Cu_3O_7$ in a radio-frequency magnetic field and in a dc magnetic field H_0, we observe novel nonlinear behavior including very-high-order odd-harmonic generation if $H_0 = 0$. If H_0not =0, there is additional even-harmonic generation. The even-harmonic power displays a very sharp dip at $H_0 \sim 0$, of width ~100 μG. This and related behavior can be semiquantitatively understood by modeling the system as a suitably averaged collection of flux-quantized supercurrent loops containing Josephson junctions.

36911 Long-range antiferromagnetic order of the Cu in oxygen-deficient RBa$_2$Cu$_3$O$_6$μ/sub x/. Li, W.; Lynn, J.W.; Mook, H.A.; Sales, B.C.; Fisk, Z. (Department of Physics, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9844-9847(1 Jun 1988).

We have employed polarized and unpolarized neutron-diffraction techniques on both powders and single crystals to establish the nature of the magnetic order of the Cu ions in oxygen deficient (non-superconducting) RBa$_2$Cu$_3$O$_6$μ/sub x/ (R = Y, Nd). Magnetic Bragg peaks of the type (h2,k2,l) are observed, which yield a magnetic structure in which the Cu spins are coupled antiferromagnetically both in the Cu-O planes as well as along the tetragonal c axis, with the spin direction in the tetragonal plane. The Neel temperature is very sensitive to the oxygen content, with T/sub N//sub (// sub x//sub ~//sub 0)/≅500 K, while the spin configuraton is independent of x.

36912 Magnetic field dependence of nonresonant microwave power dissipation in YBa$_2$Cu$_3$O$_7$√/sub x/. Tomasch, W.J.; Blackstead, H.A.; Ruggiero, S.T.; McGinn, P.J.; Clem, J.R.; Shen, K.; Weber, J.W.; Boyne, D. (Physics Department, University of Notre Dame, Notre Dame, Indiana 46556). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9864-9867(1 Jun 1988).

We report measurements of the H-dependent component of dissipated power δP/sub A/(H,T) for H = 0—19 kOe and T = 60—95 K. Powdered bulk material is exposed to the maximum H/sub ac/ (minimum E/sub ac/) field produced by a 20.9-GHz cavity. In the normal state, ac losses depend weakly on H and thus δP/sub A/ is small. δP/sub A/ increases abruptly at T/sub c/ and varies roughly as √H , consistent with unpinned vortex motion. At lower T, δP/sub A/ decreases and becomes approximately linear in H, consistent with pinning-force effects. We observe abrupt structure near H/sub c/$_1$ and an absence of hysteresis. Our method deemphasizes low-J/sub c/ material at grain boundaries. The distinctive variation of δP/sub A/(H,T) provides a signature suitable for identifying minority superconductive phases in electrically discontinuous samples.

36913 Neutron diffraction study of hydrogen positions at 13 K, domain model, and chemical composition of staurolite. Stahl, K.; Kvick, A.; Smith, J.V. (Univ. of Lund (Sweden)). *Journal of Solid State Chemistry;* **73**: No. 2, 362-380(Apr 1988). Contract AC02-76CH00016.

Comparison of new neutron and old X-ray diffraction data for single crystals of staurolite from Pizzo Forno yielded unique answers to some, but not all, outstanding structural questions. Neutron data were collected at 13(1) K for a crystal with assumed composition Li/sub 0.07/Mg/sub 0.87/Ti/sub 0.14/Cr/sub 0.01/Mn/sub 0.04/Fe/sub 3.00/$^{2+}$ Fe/sub 0.06/$^{3+}$ Co/sub 0.01/Zn/sub 0.05/Al$_{17}$.69Si/sub 7.67/O$_{48}$H/sub 3.41.F//sub 0.01/, M/sub w/ = 1671, a = 7.8639(10), b = 16.625(2), c = 5.651(2) A, β = 90.015(14)°, C2m, Z = 1, D/sub x/ = 3.75 g cm^{-3}, 1874 (1024 unique) reflections, λ = 1.1598(1) A, R(F) = 3.3%. A structural model with three types of domains is proposed: ~ 63% type 1, (Fe, etc.) + H(1); ~ 22% type 2, (Mg, etc.) + H(2); ~ 15% type 3, (Fe, etc.) without hydrogen. For the orthorhombic pseudostructure, the occupancies of the two hydrogen sites place strong restrictions on the other site occupancies. A plausible structural; formula is: [Si 7.67, Al 0.33]$_8$[Fe^{2+} 3.00, Li 0.07, Mn 0.04, Zn 0.02, Co. 0.01]/sub 3.14/[Al(1) site: Al(1) site: Al 7.94, Fe^{3+} 0.06]$_8$[Al(2) site: al 7.52, Mg 0.35, Ti 0.11, V 0.01, Cr 0.01]^8[Al(3) site: al 1.88, Mg 0.09, Ti0.03]$_2$[U site: Mg 0.41, Zn 0.02]/sub 0.43[H(2)]//sub 0.86/. For the monoclinic structure, the A and B subcomponents are less different for the crystal used for neutron diffraction than for the smaller one used for X-ray diffraction.

36914 Synthesis and structural characterization of CaTiO$_3$ doped with 0.05-7.5 mole% gadolinium(III). Larson, E.M.; Eller, P.G.; Purson, J.D.; Pace, C.F.; Eastman, M.P.; Greegor, R.B.; Lytle, F.W. (Los Alamos National Lab., NM (USA)). *Journal of Solid State Chemistry;* **73**: No. 2, 480-487(Apr 1988). Contract FG06-84ER45121.

Titanates containing 0.05-7.5 mole% gadolinium(III) in the CaTiO$_3$ perovskite lattice have been prepared and characterized by X-ray diffraction and absorption, electron paramagnetic resonance, and Raman methods. The structural studies confirm the predicted site substitution of Gd^{3+} ions into the Ca^{2+} sites and suggest charge compensation by a cation deficiency mechanism (Ca^{2+} andor Ti^{4+} vacancies). Evidence is presented for a significant difference between local Gd^{3+} -substituted sites and the average Ca(Gd) sites, resulting from the difference in charge and size of the two ions. A least-squares refinement of single-crystal X-ray data was carried out on (Ca/sub 0.925/Gd/sub 0.0975/)TiO$_3$, with resulting cell parameters and major structural features within three standard deviations of those previously found for stoichiometric CaTiO$_3$: space group Pbnm, a = 5.381(1), b = 5.449(1), c = 7.647(1) A, Z = 4, R = 4.1% for 236 reflections with I ≧ 2σ(I).

36915 Structural studies of Li/sub 0.7/VO$_2$ in the temperature range 20-300°C. Cardoso, L.P.; Cox, D.E.; Hewston, T.A.; Chamberland, B.L. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Solid State Chemistry;* **72**: No. 2, 234-243(Feb 1988). Contract AC02-76CH00016.

The ordered rock-salt type compound Li/sub 0.7/VO$_2$ has recently been found to exhibit some unusually large hysteresis effects in its magnetic and thermal properties between 150 and 280°C, related to the magnetic transition known to occur at about 190°C in LiVO$_2$. X-ray and neutron powder diffraction measurements have been made on samples of Li/sub 0.7/VO$_2$ in an effort to classify structural changes believed to accompany this transition but not hitherto reported in any detail. The unit cell parameters were found to change from a = 2.837, c = 14.775 A at 24°C to a = 2.913, c = 14.640 A at 263°C, with a large discontinuity in the transition region. Rietveld refinement was carried out on X-ray data collected at these temperatures and on neutron data collected at 35°C, the main change being an increase in the V-O and V-V distances from 1.98 and 2.84 A at 24°C to 2.02 and 2.91 A at 263°C, respectively. The only indication of any departure from R3m symmetry in the low-temperature phase was the presence of two extremely weak superlattice peaks in the 24°C X-ray data which can be indexed in terms of an enlarged cell with a' = a √3,c' = c. Above 250°C, the gradual development of a second phase was noted, identified as the cubic spinel LiV$_2$O$_4$ resulting from the disproportionation of Li/sub 0.7/VO$_2$ into LiVO$_2$ and the spinel. Hysteresis effects were observed in the X-ray data which closely parallel those previously reported for the magnetic and thermal properties and which can be attributed to the disproportionation reaction.

36916 Preparation and crystal structures of plutonium(IV) hexachloro complexes, Rb$_2$PuCl$_6$ and K$_2$PuCl$_6$. Morss, L.R.; Fujino, T. (Argonne National Lab., IL (USA)). *Journal of Solid State Chemistry;* **72**: No. 2, 338-352(Feb 1988). Contract W-31-109-ENG-38.

Rb$_2$PuCl$_6$ and K$_2$PuCl$_6$ were prepared by heating mixtures of anhydrous PuCl$_3$ and the respective alkali metal chlorides under high Cl$_2$ pressures. Their crystal structures were determined by powder X-ray crystallography. Rb$_2$PuCl$_6$: hexagonal, space group P6$_3$mc, a = 7.377 +- 0.002, c = 11.880 +- 0.007 A, Z = 2, V = 279.9 +- 0.3 A^3 (per formula), D/sub x/ = 3.69 gcm^3. K$_2$PuCl$_6$: monoclinic, space group P2m, a = 7.218 +- 0.005, b = 7.611 +- 0.006, c = 10.208 +- 0.007 A, β = 91.59 +- 0.04°, Z = 2, V = 280.3 +- 0.3 A^3 (per formula), D/sub x/ = 3.14 gcm^3. The variable atom parameters were obtained by means of electrostatic calculation to have the maximum Madelung constant. Raman spectra showed two lines corresponding to ν$_1$(A/sub 1g/) and ν$_5$(F/sub 2g) for both compounds. The difference of stability in M$_2$PuCl$_6$ (M = K, Rb, Cs) is discussed.

36917 Preparation and crystal structures of plutonium(III) pentachloro complexes, K$_2$PuCl$_5$ and Rb$_2$PuCl$_5$. Morss, L.R.; Fujino, T. (Argonne National Lab., IL (USA)). *Journal of Solid State Chemistry;* **72**: No. 2, 353-362(Feb 1988). Contract W-31-109-ENG-38.

K$_2$PuCl$_5$ and Rb$_2$PuCl$_5$ were prepared by heating mixtures of anhydrous PuCl$_3$ and respective alkali metal chlorides in vacuum-sealed quartz ampoules at 400-500°C. Their crystal structures are both orthorhombic with K$_2$PrCl$_5$-type structure (space group Pnma, Z = 4), determined by powder X-ray crystallogra-

phy. K_2PuCl_5: lattice parameters a = 12,674 +/- 0.003, b = 8.727 +/- 0.002, c = 7.969 +/- 0.002 A; cell volume 220.4 +/- 0.2 A^3; X-ray density 3.726 +/- 0.004 g/cm^3. Rb_2PuCl_5: lattice parameters a = 13.093 +/- 0.008, b = 8.909 +/- 0.005, c = 8.178 +/- 0.005 A; cell volume 238.5 +/- 0.4 A^3; X-ray density 4.088 +/- 0.008 g/cm^3. Fourteen variable atom parameters of these complexes were obtained by electrostatic calculation with a program which maximizes the Madelung constant under the condition that the ion-ion separations in the crystal are all larger than respective critical distances. The measured Raman lines of Rb_2PuCl_5 are very close to those of hexachloride complexes. The bond lengths and stability of M_2PuCl_5 (M = K, Rb) are discussed.

3606 Other Materials

REFER ALSO TO CITATION(S) 35756, 35789, 35810, 35813, 35814, 35815, 35816, 35840, 36003, 36005, 36037, 36046, 36127, 36322, 36466, 36495, 36717, 36746, 36778, 36875, 36889, 37167, 37285, 37331, 37361, 37365, 37371, 37372, 37390, 37391, 37397, 37541, 37589, 38222, 38714

36918 (AD-A—190034/9/XAB) Molecular dynamics of materials possessing high energy content. Final report, 1 November 1985-31 October 1987. Turro, N.J. (Columbia Univ., New York (USA)). 26 Jan 1988. 17p. NTIS, PC A03/MF A01.

The accomplished research has centered about the construction of new instrumentation for the investigation of transient high-energy materials and the exploration of how the chemistry of transient high-energy materials and the dynamics of these species respond to systematic variations in structure, environments, and experimental variables. Particular emphasis was given to reactions in microheterogeneous environments and interfaces provided by micelles, polymers and porous solids, using resonance Raman spectroscopy, nuclear magnetic resonance spectroscopy, electron spin-resonance spectroscopy, optical absorption, and optical emission. The use of external magnetic fields on the reactivity of carbenes, of radical pairs, and of biradicals, and of adsorption of reactive intermediates at interfaces was explored as methods which may be capable of extending the lifetimes of these transient species.

36919 (AD-A—190082/8/XAB) Chalcogenide glasses. Taylor, P.C. (Utah Univ., Salt Lake City (USA). Dept. of Physics). 15 Aug 1987. 4p. (—83-K-0535-14). NTIS, PC A02/MF A01.

Pub. in MRS Bulletin, 36-38(16 Jun-15 Aug 1987).

Although there are some significant exceptions, most important glass-forming systems contain elements from the sixth, or chalcogenide, column of the periodic table (oxygen, sulfur, selenium, or tellurium). The glasses that contain oxygen are typically insulators, while those that contain the heavier chalcogen elements are usually semiconductors. Even though oxygen is technically a chalcogen element, the term chalcogenide glass is commonly used to denote those largely covalent, semiconducting glasses contain sulfur, selenium, or tellurium as one of the constituents.

36920 (AD-A—190087/7/XAB) Optical properties of InP doping superlattices grown by metal/organic chemical vapor deposition. Gal, M.; Viner, J.M.; Taylor, P.C. (Utah Univ., Salt Lake City (USA). Dept. of Physics). Apr 1987. 6p. (—83-K-0535-15). NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science and Technology B, Vol. 5, No. 2, 504-507(Mar-Apr 1987).

Recently the authors reported the first InP superlattice grown by organometallic vapor-phase epitaxy (organometallic vapor-phase epitaxy or metal/organic chemical vapor deposition) technique. These samples were grown in an atmospheric-pressure reactor using trimethylindium and phosphine in a hydrogen ambient. The n- and p-type dopants were diethyltellurium and dimethylzinc, respectively. Several experiments indicate that the interfaces between n and p regions in these structures are sharp and of high quality. The peak energy and the line shape of the photoluminescence spectra depend on the excitation intensity just as predicted theoretically. In addition, time decay of the luminescence contains distinct steps, indicating the existence of subbands due to quantum size effects. The first photo-reflectance (PR) measurements were also performed on these doping superlattices. These measurements show that the photoexcited carriers modulate the subband levels in a very predictable fashion. The observed PR line shapes are well explained by photomodulation of the subbands in the conduction band.

36921 (AD-A—190374/9/XAB) Low-cost electromagnetic shielding using drywall composites: results of RFI (radio-frequency interference) testing of a shielding effectiveness. Final technical report. Williams, P.F.; Heyen, K.K.; McCormack, R.G. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Oct 1987. 60p. (CERL-TR-M—88/02). NTIS, PC A04/MF A01.

Because of developments in electronics technology, the need for electromagnetic shielding has increased. To reduce the cost of this shielding, new materials are needed. The U.S. Army Corps of Engineers, Fort Worth District (FWD), and the U.S. Army Construction Engineering Research Laboratory (USA-CERL) have developed composite materials that use standard, construction-grade, aluminum foil-backed gypsum board in combination with either a metal mesh or lead foil. Special seams for these composites were designed by U.S. Gypsum Company. USA-CERL evaluated the adequacy of each material and seam design by using radio-frequency antennas and receivers to measure its shielding effectiveness when mounted in the wall of a shielded room. These evaluations showed that the composite panels met the specified requirement of 60 decibels (dB) of shielding. The composites were also shown to be adequate for most communications security applications. However, the addition of a seam decreased shielding by as much as 10 dB.

36922 (BFR-R—104-1986) Thermal transfer characteristics of Swedish soils. Thermal conductivity, specific thermal capacity and latent heat. Sundberg, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 125p. (In Swedish). NTIS (US Sales Only), PC A06. Order Number DE88752902/JAW.

The objective of this project has been to determine the thermal transfer characteristics of Swedish soils. Variations of up to a factor of 10 can be encountered, depending on the type of soil, water content, porosity etc. Water content is a very important parameter for thermal conductivity, thermal capacity and latent heat of freezing. Water content at a given site is determined by the water retention characteristics of the soil and by the depth down to the ground-water table. Fine-grained soils, such as clay and silt, have excellent water retention characteristics, while sand and coarser soils have considerably poorer characteristics. Mineral content is of importance primarily for thermal conductivity. A sand with a high quartz content can exhibit a thermal conductivity 40 percent higher than that of clay. The work of the project has therefore also included investigation of the mineral content of various types of soil. A total of over 900 measurements of thermal conductivity in common Swedish soils have been made. Measurements of water content, density, humus content, grain size and water retention characteristics have also been made at the same time. Diagrams have been drawn showing the thermal conductivity and thermal capacity of frozen and unfrozen ground, and of latent heat. Entry parameters in the diagrams are dry density, degree of water saturation and type of soil. With 37 refs.

36923 (BFR-R—107-1986) Curing of structual concrete with infrared radiant heat. Nilsson, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 76p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752904/JAW.

This report shows how the measures necessary for the curing of structural concrete, in order that the intended strength may be achieved within the specified time, can be determined by means of computer calculations. In these calculations, the effect of e.g. different types of formwork or thermal insulation, the time of formwork is struck, application and removal of thermal insulation, and varying degrees of heating, can be studied. On the basis of the above, the combination of measures which meets the specified strength requirements as a given age and which produces the lowest cost for each particular pour, can be selected. This method is an alternative to the selection of measures 'by feel' or 'on the

basis of experience' or by using collections of diagrams. However, the results are only as reliable as the input data selected for the calculations. Examples of factors of uncertainty are assumptions regarding outdoor temperature and wind velocity. With particular reference to radiant heating, the efficiencies of liquefied gas and electric radiant heaters are analyzed, and the absorption capacity of formwork material and concrete are investigated. Development of temperature in concrete floors is simulated for different climatic, insulation and heating conditions. The calculated temperature development and concrete strength are compared with the results of field studies made during winter pours of concrete floors in the course of normal production. Reduction of strength due to heat curing and deflections of concrete floors due to early striking of formwork are discussed and countermeasures are proposed. With 28 refs.

36924 (BNL—41200) Ionic conductive polymers based on crosslinked elastic siloxane-ethylene oxide copolymers. Mei, H.L.; Okamoto, Y.; Skotheim, T.; Harris, C.S. (Polytechnic Univ., Brooklyn, NY (USA). Polymer Research Inst.; Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 26p. (CONF-8710283—5). NTIS, PC A03;3. Order Number DE88011243/JAW.

From Symposium on electroresponsive polymers; Upton, NY, USA (4 Oct 1987).

Rubber-like elastic materials of poly(phenylsiloxane-ethylene oxide) crosslinked copolymers were synthesized and complexes with CF_3SO_3Li were made. The highest ionic conductivity was observed for the polymersalt complex with the number of EO unit n = 7 and OLi = 12. The room temperature conductivity is considerably higher than that of PEO-alkali metal salt complexes. Both Arrhenius (n= 23 and 34) and VTF (n = 3, 7, 9, and 14) type behavior for the temperature dependence of the conductivity were observed. These systems were found to be thermally stable in dry condition up to at least 225{degree}C. 12 refs., 9 figs., 1 tab.

36925 (CONF-880118—8) Observations on residual stresses in ceramic composites by neutron diffraction techniques. Majumdar, S.; Kupperman, D.S.; Singh, J.P. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31-109-ENG-38. 32p. (CONF-880118—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009937/JAW.

From 12. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (20 Jan 1988).

This paper presents a comparison between the residual thermal stresses and strains, developed during cooling of a ceramic-ceramic (SiC–Al_2O_3) composite, determined by analytical methods and by an experimental neutron diffraction technique. Because the coefficient of thermal contraction of the matrix (Al_2O_3) is greater than that of the residual stresses were determined by using two self-consistent models. In the first, a plane strain composite cylinder model, the fibers are approximated as infinitely long circular cylinders. In the second, due to Eshelby, the fibers are approximated as ellipsoids (specialized to prolate spheroids in this case). The two models give almost identical estimates of the stresses and strains in the fibers. The interpretation of the measured strains in the fibers by neutron scattering has some uncertainty because of the lack of a clearly defined crystal structure of SiC. However, in general, the measured and calculated strains are reasonably close. 15 refs., 8 figs.

36926 (CONF-880417—14) Mechanical properties and deformation of polycrystalline lithium orthosilicate. Bar, K.; Chu, C.Y.; Singh, J.P.; Goretta, K.C.; Routbort, J.L.; Billone, M.C.; Poeppel, R.B. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009936/JAW.

From International symposium on nuclear fusion technology; Tokyo, Japan (10 Apr 1988).

Room-temperature strength, fracture toughness, Young's modulus, and thermal-shock resistance were determined for 68–98% dense lithium orthosilicate (Li_4SiO_4) specimens. In the low-density regime, both strength and fracture toughness were controlled by the density of the specimen. At high density, the strength depends on grain size. Young's modulus values ranged from 30–103 GPa at densities between 68 and 98% TD. A critical quenching temperature difference in the range of 150–170{degree}C was observed in thermal-shock tests of bar specimens. Steady-state creep tests indicated 90% dense Li_4SiO_4 fractures at T $\leq$ 800{degree}C before reaching steady state and deforms plastically at 900{degree}C. It is more creep-resistant at 900{degree}C than Li_2O, about equal to Li_2Zr_3, and less than $LiA10_2$. 13 refs., 4 figs., 1 tab.

36927 (CONF-880613—8) In situ HVEM investigation of catastrophic swelling in uranium intermetallic fuels. Birtcher, R.C.; Allen, C.W.; Hofman, G.L.; Rehn, L.E. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 15p. (CONF-880613—). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009991/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

The swelling of intermetallic materials depends upon the crystalline or amorphous state of the material. When U_3Si is irradiated at temperatures above its amorphization limit, it remains crystalline and does not suffer extraordinary swelling. However, when it is irradiated at temperatures below its amorphization limit, body forces associated with the irradiation cause any internal free volume to suffer a rapid growth, and the material swells at an anomalously fast rate. As has been previously noted, fission-gas bubbles are not directly responsible for this swelling; however, once formed, the bubble volume, as any interior volume, may increase rapidly. An unusual and important result is that once U_3Si has been irradiated to a high fluence, (above 2 {times} 10^{20} Kr m/sup {minus/2}), the irradiation behavior appropriate for the initial irradiation temperature is locked in, at least temporarily, and that behavior persists even at irradiation temperatures that normally result in the opposite behavior. For example, after a 620{degree}K irradiation, the crystalline state is retained during subsequent irradiation at 420{degree}K to more than ten times the fluence required to amorphize unirradiated material at 420{degree}K. 19 refs., 3 figs.

36928 (CONF-8804112—3) Atomistic simulation of silicon grain boundaries. Phillpot, S.R.; Wolf, D. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009925/JAW.

From Interfacial structure, properties and designs in solids; Reno, NV, USA (5 Apr 1988).

The bond-bending and bond-stretching three-body potential of Stillinger and Weber is used to study the energy and structure of grain boundaries in silicon. 10 refs., 3 figs.

36929 (CONF-8806103—1) Factors influencing the toughening behavior of whisker reinforced ceramics. Becher, P.F.; Hsueh, Chung-Hway; Angelini, P.; Tiegs, T.N. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011396/JAW.

From International conference on whisker- and fiber-toughened ceramics; Oak Ridge, TN, USA (7 Jun 1988).

Whisker reinforced ceramics exhibit substantial improvements in fracture toughness and other mechanical properties as compared to the unreinforced ceramics. In many of the whisker reinforced ceramics, enhanced toughness is derived from bridging of the crack by the strong whiskers. An analysis of the whisker bridging contribution reveals that the toughness is a function of the whisker strength, radius, and volume content, the ratio of the Young's modulus of the composite to that of the whisker, and the ratio of the fracture energy of the matrix to that of the whisker-matrix interface. Recent studies show that the analysis based on whisker bridging quantitatively describes the experimentally observed toughening that results from whisker reinforcement. 9 refs., 1 fig.

36930 (CONF-8806155—1) Theoretical and experimental analysis of the toughening behavior of whisker reinforcement in ceramic matrix composites. Becher, P.F.; Hsueh, C.H.; Angelini, P.; Tiegs, T.N. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011841/JAW.

From Symposium on interfacial phenomena in composites; Newport, RI, USA (1 Jun 1988).

Analytical solutions are presented describing the experimentally verified toughening of whisker reinforced ceramics. Clear insights are provided into the interrelationships of whiskers, matrices, and interfaces in the case of strong interfaces with minimized whisker pullout.

36931 (DOE/ER/13411—3) Ligand intermediates in metal catalyzed reactions. Technical report: third budget year. Gladysz, J.A. (Utah Univ., Salt Lake City (USA)). 1 Apr 1988. Contract FG02-85ER13411. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012123/JAW.

A progress report is presented in which a new method for the activation of metal-bound methyl groups and the oxidative disproportionation of coordinated ethylene and methane are discussed. Also considered in the report is the divergent kinetic and thermodynamic acidity in organotransition metal hydride complexes and the synthesis, structure, and reactions of chiral rhenium vinylidene complexes.

36932 (DOE/ER/13622—2) Structural and electronic properties of iron and cobalt molecular sieve catalysts: Progress report. Suib, S.L. (Connecticut Univ., Storrs (USA)). 14 May 1988. Contract FG02-86ER13622. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010537/JAW.

During the second year of this research we have focused on the characterization of highly dispersed cobalt and iron particles in zeolites with transmission electron microscopy and spin echo nuclear magnetic resonance techniques. We have continued our studies of the structure sensitivity of cyclopropane craking reaction. In-situ Moessbauer studies of iron catalysts have also been done. In addition, several ultahigh vacuum methods have been used to characterize metal-containing molecular sieves. The most significant discovery is that spin echo nuclear magnetic resonance (SENMR) methods can be used to determine the structure of small (5--40 angstrom) size particles of cobalt. Both hexagonal and cubic metal particles have been prepared and a new alloy of cobalt and iron has been characterized by SENMR. This is the first example of the use of spin echo nuclear magnetic resonance methods done in zero external magnetic field for supported catalysts. With this method the relaxation times of different cobalt species can be determined.

36933 (DOE/ER/13789—1) Studies of photochemically and electrochemically driven electron transport in zeolites: Progress report, September 1987-April 1988. Mallouk, T.E. (Texas Univ., Austin (USA). Dept. of Chemistry). Apr 1988. Contract FG05-87ER13789. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008644/JAW.

Electron transfer reactions in zeolites and related solid-state materials are being studied. Some particular areas of study are: Electron transfer reactions of linked sensitizer-acceptor molecules. We have studied via laser flash photolysistransient absorbance the photochemistry of linked Ru(bpy)$_3$--diquat molecules exchanged onto the outer surface of zeolite L powder. Electron-donor quenching of excited-state RuL$_3$ complexes. We have studied electron transfer reactions between cyanometallate anions M(CN)$_6$/sup {4 minus/}(M = Mo,W), M(CN)$_6$/sup {4 minus/}(M = Fe,Os) and excited state ruthenium complexes. Quantum-size TiO_2 in zeolite L. We are attempting to prepare systems in which the conduction band of an oxide semiconductor is used to convey electrons from a sensitizer to a catalyst within a zeolite L particle. Internal platinization of pillared clays. We have photoplatinized dispersed Na^+--montmorillonite, using $PtCl_4$/sup {2 minus/}as the platinum source, and then pillared the clay with A1(OH)$_2$C1 solutions. We are currently investigating the size and charge selectivity of these catalytic materials.

36934 (DOE/ER/45048—5) Photoreflectance spectroscopy of GaAs-Al/sub x/Ga/sub 1-x/As quantum wells under hydrostatic pressure. Kangarlu, A.; Chandrasekhar, H.R.; Chandrasekhar, M.; Chambers, F.A.; Vojak, B.A.; Meese, J.M. (Missouri Univ., Columbia (USA). Dept. of Physics and Astronomy; Amoco Research Center, Naperville, IL (USA)). 1986. Contract AC02-84ER45048. 4p. (CONF-860892—6). NTIS, PC A02;3. Order Number DE88009855/JAW.

From 18. international conference on physics of semiconductors; Stockholm, Sweden (11 Aug 1986).

We present the first study of the effect of hydrostatic pressure on the photoreflectance (PR) spectra of GaAs - Al/sub x/Ga/sub 1{minus/x}As multiple quantum wells (MQW). As the levels in the CB move up in energy with pressure, they interfere with the L band signalled by a loss of intensity as they cross the latter. At pressures beyond 35 kbar the CB of GaAs crosses the L band of GaAs and the X band of the Al/sub x/Ga/sub 1{minus/x}As barrier. Staggered transitions across the interface from the X CB of Al/sub x/Ga/sub 1{minus/x}As to the valence band of GaAs are seen signalling the formation of a type II heterostructure beyond these pressures. The valence band offsets are deduced from this data and are in agreement with our published data of photoluminescence under pressure. The pressure dependence of the L band is also deduced from our results. 7 refs., 3 figs.

36935 (DOE/ER/45104—3) [Synthesis of model polymers and related structures in support of vinyl monomer grafting studies]: Progress report, July 1, 1987-June 30, 1988. Hogen-Esch, T.E.; Butler, G.B. (Florida Univ., Gainesville (USA)). 1988. Contract FG05-84ER45104. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010245/JAW.

Objectives of the present program include the synthesis, structural characterization and properties, of cellulose-based water-soluble graft copolymers and other copolymers capable of effectively enhancing the viscosity of their aqueous solutions. In support of this program we plan the synthesis of a number of water-soluble well defined block- or star block colopymers capable of effectively viscosifying their solutions through reversible crosslinking. In order to understand the effects on the rheology of branching or cyclization in the above systems, we also plan the synthesis of water-soluble cyclic- and star polymers.

36936 (DOE/ER/45114—5) Statistical mechanics of polymer systems: Annual report. Kovac, J. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1 May 1988. Contract FG05-84ER45114. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011172/JAW.

This project involves two different, but complementary, efforts. The first is the development and application of dynamic Monte Carlo computer simulation techniques for the study of polymer dynamics. The second is the study of equilibrium and nonequilibrium aspects of the glass transition. Progress has been made in both areas during the previous year. 8 refs.

36937 (DOE/ER/45123—4) Fundamental studies of elastomers: Annual report, February 16, 1987-March 15, 1988. Eichinger, B.E. (Washington Univ., Seattle (USA). Dept. of Chemistry). 15 Mar 1988. Contract FG06-84ER45123. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009679/JAW.

This progress report describes work in the three areas of (1) computer simulation, (2) theory of the shape distribution of polymer chains, and (3) synthetic projects on elastomers. Areas of study include: the influence of chain scission on the radiation cure of polyethylene; crosslinking in urethane formation; calculations on spherical distributions for linear and circular chains; gel synthesis; derivitization of commercial elastomers to incorporate acetylacetone; synthesis of polysilylenes; polymerization of a strained bicyclic olefin. 6 figs. (CBS)

36938 (DOE/ER/45250—1) Investigations on the MBE [molecular beam epitaxy] growth and properties of Al/sub y/Ga/sub y/In/sub 1-x-y/AsInP and InGaAs-InAlAs superlattices: Progress report for the period February 1, 1987-December 31, 1987. Bhattacharya, P.K.; Gibala, R. (Michigan Univ., Ann Arbor (USA)). 1987. Contract FG02-86ER45250. 46p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009105/JAW.

Focus of the work was to grow wide-bandgap ternary and quaternary semiconductors InAlAs and InGaAlAs by molecular beam epitaxy and to investigate their electronic, optical and structural characteristics. Techniques being used are x-ray, TEM, photoluminescence and absorption, DLTS, Hall transport, and Raman Spectroscopy. Experiments included both lattice matched and strained layers. We have grown a series of InGaAlAs quaternary alloys lattice matched to InP, covering the bandgap range from 0.75 to 1.45 eV. Low-temperature photoluminescence measurements indicate that the layers are possibly the best ever grown. The excitonic linewidths are extremely narrow and indicate minimal amounts of clustering. The hole lifetimes in the alloys are comparable to those in high-purity GaAs. Deep levels in these alloys are being investigated and several dominant trap centers have been identified. Studies are under way to establish their physico-chemical origin. Preliminary Raman Spectroscopy measurements have been done on the same samples and the data are being analyzed. Intention is to establish the GaAs, AlAs and InAs-like phonon spectra as a function of composition. We have realized the narrowest PL excitonic linewidths in InGaAs/GaAs MQWs. The linewidths {approximately} 1-2 meV are almost a factor of 3 better than anything ever reported previously. A proper understanding of strained layer epitaxy by non-equilibrium growth techniques such as MBE is emerging for the first time. 27 figs., 2 tabs.

36939 (DOE/ER/45252—T2) [The mechanical behavior of surface modified ceramics]: Progress report. (Pennsylvania State Univ., University Park (USA)). 1988. Contract FG02-86ER45252. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010564/JAW.

Ceramics can be strengthened by compressive stresses on the surface. This can be done either thermally (tempering of glasses), chemically (ion exchange, doping) or physically (thermal expansion of surface and bulk). Vicker's indentation techniques were used to estimate the residual stresses on surfaces. Aluminosilicate glass samples were ion exchanged in molten KNO_3 at a constant temperature for 2 min--25 h. The samples were then indented using a Vicker's diamond indentor. An attempt was also made to find a suitable infiltrant for surface modification of alumina with chromia. Solid state diffusion was examined. Samples were heated in powder beds containing Cr_2O_3 and various amounts of CrF_3, 3.5 H_2O (0,5,10,15,20) at 1500{degree}C for various times. Electron microprobe analysis and scanning electron microscopy with x-ray dispersive analysis were used. Residual stresses in thermal barrier coatings were also investigated. Plasma-sprayed thermal barrier coatings (TBC's) applied to superalloy jet turbine blades increase oxidation resistance and allow higher operating temperatures. Due to the plasma-spray process, microstrains and small coherently diffracting regions are introduced into the TBC's. 4 refs.

36940 (DOE/ER/45278—1) Structure and properties of 3 to 5 interfaces: Progress report 87/88. Ast, D.G. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Mar 1988. Contract FG02-86ER45278. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009216/JAW.

We investigated three different aspects of the pseudomorphic system In/sub x/Ga/sub 1-x/As on GaAs. These subsets were: 1) the formation and location of dislocations at the interface between In/sub x/Ga/sub 1-x/As and GaAs (with IBM); 2) the electrical properties of interface dislocations at the emitter base and base collector junctions of inverted and non inverted heterojunction bipolar transistors (with EE Cornell); and 3) the suppression of misfit dislocations in pseudomorphic systems grown well beyond the critical thickness (with IBM). Details of these investigations are listed in the attached publications. Therefore, we will report below only the central ideas and most essential results.

36941 (DP-MS—87-157) Prediction of glass durability as a function of glass composition and test conditions: Thermodynamics and kinetics. Jantzen, C.M. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 19p. (CONF-8806111—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010893/JAW.

From Conference on the advances in fusion of glass; Alfred, NY, USA (14 Jun 1988).

The long-term durability of nuclear waste glasses can be predicted by comparing their performance to natural and ancient glasses. Glass durability is a function of the kinetic and thermodynamic stability of glass in solution. The relationship between the kinetic and thermodynamic aspects of glass durability can be understood when the relative contributions of glass composition and imposed test conditions are delineated. Glass durability has been shown to be a function of the thermodynamic hydration free energy which can be calculated from the glass composition. Hydration thermodynamics also furnishes a quantitative frame of reference to understand how various test parameters affect glass durability. Linear relationships have been determined between the logarithmic extent of hydration and the calculated hydration free energy for several different test geometries. Different test conditions result in different kinetic reactivity parameters such as the exposed glass surface area (SA), the leachant solution volume (V), and the length of time that the glass is in the leachant (t). Leachate concentrations are known to be a function of the kinetic test parameter (SAV)t. The relative durabilities of glasses, including pure silica, obsidians, nuclear waste glasses, medieval window glasses, and frit glasses define a plane in three dimensional ΔG/sub hyd/-concentration-(SAV)t space. At constant kinetic conditions, e.g., test geometry and test duration, the three dimensional plane is intersected at constant (SAV)t and the ΔG/sub hyd/-concentration plots have similar slopes. The slope represents the natural logarithm of the theoretical slope, (12.303 RT), for the rate of glass dissolution. 53 refs., 4 figs.

36942 (FNAL-TM—1517) Thermophysical properties of argon. Jaques, A. (Fermi National Accelerator Lab., Batavia, IL (USA)). Feb 1988. Contract AC02-76CH03000. 201p. NTIS, PC A10. Order Number DE88010376/JAW.

The entire report consists of tables of thermodynamic properties (including sound velocity, thermal conductivity and diffusivity, Prandtl number, density) of argon at 86 to 400{degree}K, in the form of isobars over 0.9 to 100 bars. (DLC)

36943 (FRCEA-TH—49) Magnetic and superconductive property study of the compounds: $HoMo_6S_8$, $EuMo_6S_8$ and Ce Mo_6S_8. Dinia, M.A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; Grenoble-1 Univ., 38 (France)). Jul 1987. 173p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753964/JAW.

Magnetic measurements and neutron spectroscopy measurements allowed to conclude that $HoMo_6S_8$ was an Ising system. Neutron diffraction experiments and electric conductivity measurements simultaneously on a $HoMo_6S_8$ monocrystal allowed to set that at null field superconductivity exists not only with the modulated magnetic structure but also with an antiphase magnetic structure (in a narrow temperature range). Superconductivity disparition at low temperature is then not related to the magnetic transition but to the development of magnetic moments of Ho^{3+} ions. Superconducting phase got at low temperature by heating a monodomain ferromagnetic crystal is associated to a reduction of the ordered moment of Ho^{3+} ions, because of an important demagnetizing field. At last, magnetic order evolution study in relation to the magnetic field allowed to precise the phase diagram of $HoMo_6S_8$. A crystal structure study of $EuMo_6S_8$ in the high temperature rhomboedric phase and the low temperature triclinic phase were realized by neutron diffraction. Magnetic order in $EuMo_6S_8$ below T/sub /N = 0.3K was determined.

36944 (IS-T—1335) The crystal and molecular structures of a tricyclic phosphorus ester, a cobalt(III) macrocyclic complex and a trans coordinated platinum(II) compound. Wintergrass, D.J. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88007354/JAW.

The reaction chemistry and structurebonding features of some new hypercoordinate and strained non-metal compounds have been investigated. In an effort to create a species containing hypervalent phosphorus, 7-hydroxymethyl-4-phospha-3,5,9-trioxa-tricyclo undecane was refluxed for one hour in chloroform. However, the resulting product, 4-hydro-4-oxa-4-phospha-3,5,9-trioxa-tricyclo dodecane did not contain a hypercoordinate phosphorus atom. A molecular structure determination of this phosphonate was carried out to determine the conformation and thereby help elucidate a possible reaction mechanism. A macrocyclic organocobalt compound was prepared by photolysis. The complex which was examined by x-ray crystallography is trans-ethylaquocobalt(1,4,8,11-tetraazacyclotetradecane)perchlorate. Determination of the molecular structure was undertaken. The compound trans-di-chloro-bis-[2,8,9-trimethyl-1-phospha-2,5,8,9-tetraazabicyclo undecane]platinum(II) was prepared by a displacement reaction of the ligand, 2,8,9-trimethyl-1-phospha-2,5,8,9-tetraazabicyclo undecane, and trans-$PtCl_2${center←dot}$2Et_2S$ in either. A molecular structure determination was undertaken to determine the conformation and to complement other spectral analyses. 27 refs., 12 figs., 19 tabs.

36945 (LA—11253-MS) SESAME equation of state No. 7530, basalt. Barnes, J.F.; Lyon, S.P. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 10p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010483/JAW.

A full-range equation of state (EOS) for dry, nonporous basalt with a grain density of 2.868 gcm^3 has been constructed and placed on the SESAME library as material number 7530.

36946 (LBL—24157) Fermi level dependent native defect formation: Consequences for metal-semiconductor and semiconductor-semiconductor interfaces. Walukiewicz, W. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 25p. (CONF-880208—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008247/JAW.

From 15. annual conference on physics and chemistry of semiconductor interfaces; Asilomar, CA, USA (1 Feb 1988).

The amphoteric native defect model of the Schottky barrier formation is used to analyze the Fermi level pinning at metal/semiconductor interfaces for submonolayer metal coverages. It is assumed that the energy required for defect generation is released in the process of surface back-relaxation. Model calculations for metal/GaAs interfaces show a weak dependence of the Fermi level pinning on the thickness of metal deposited at room temperature. This weak dependence indicates a strong dependence of the defect formation energy on the Fermi level, a unique feature of amphoteric native defects. This result is in very good agreement with experimental data. It is shown that a very distinct asymmetry in the Fermi level pinning on p- and n-type GaAs observed at liquid nitrogen temperatures can be understood in terms of much different recombination rates for amphoteric native defects in those two types of materials. Also, it is demonstrated that the Fermi level stabilization energy, a central concept of the amphoteric defect system, plays a fundamental role in other phenomena in semiconductors such as semiconductor/semiconductor heterointerface intermixing and saturation of free carrier concentration. 33 refs., 6 figs.

36947 (NUCLEBRAS-CDTN—592) Monocrystal growth and characterization of HgI_2 semiconductor compound for using in X and gamma spectrometries. Faria, L.O. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1987. 94p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702476/JAW.

Mercury Iodide (HgI_2) platelets were grown from the vapor phase in the presence of polymers. These platelets are convenient to be used as room temperature operating semiconductor radiation detectors. Experiments demonstrate that the growth of platelets depends on a two-stage mass transport instead of depending on just one, as it has been thought. HgI_2 platelets 30 mm^2 large and 90 μm thick were obtained in a sealed evacuated fused quartz tube and were characterized by etch pit density measurements.

36948 (PNL—5577-2-3-4) Fabrication and characterization of MCC [Materials Characterization Center] approved testing material—ATM-2, ATM-3, and ATM-4 glasses. Wald, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 28p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008067/JAW.

Materials Characterization Center glasses ATM-2, ATM-3, and ATM-4 are designed to simulate high-level waste glasses that are likely to result from the reprocessing of commercial nuclear reactor fuels. The three Approved Testing Materials (ATMs) are borosilicate glasses based upon the MCC-76-68 glass composition. One radioisotope was added to form each ATM. The radioisotopes added to form ATM-2, ATM-3, and ATM-4 were ^{241}Am, ^{237}Np, and ^{239}Pu, respectively. Each of the ATM lots was produced in a nominal lot size of 450 g from feed stock melted in a nitrogen-atmosphere glove box at 1200{degree}C in a platinum crucible. Each ATM was then cast into bars. Analyzed compositions of these glasses are listed. The nonradioactive elements were analyzed by inductively coupled argon plasma atomic emission spectroscopy (ICP), and the radioisotope analyses were done by alpha energy analysis. Results are discussed. 7 refs., 3 figs., 5 tabs.

36949 (SAND—87-2508C) Plasma treatment of polymers for improved adhesion. Kelber, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880408—27). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011623/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

A variety of plasma treatments of polymer surfaces for improved adhesion are reviewed: noble and reactive gas treatment of fluoropolymers; noble and reactive treatment of polyolefins, and plasma-induced amination of polymer fibers. The plasma induced surface chemical and morphological changes are discussed, as are the mechanisms of adhesion to polymeric adhesives, particularly epoxy. Noble gas plasma etching of flouropolymers produces a partially defluorinated, textured surface. The mechanical interlocking of this textured surface is the primary cause of improved adhesion to epoxy. Reactive gas plasmas also induce defluorination, but oxygen containing gases cause continual ablation of the fluoropolymer surface. Noble and reactive gas (exept for hydrogen) etching of polyolefins results in surface oxidation and improved adhesion via hydrogen bonding of these oxygen containing groups across the interface. The introduction of amine groups to a polymer surface by amonia or amine plasma treatment generally results in improved adhesion to epoxy. However, amine-epoxy ring interactions can be severely effected by steric factors due to chemical groups surrounding the amine. 41 refs.

36950 (SAND—87-2667C) Chemical kinetics of hydrogen and P/sub b/ centers. Brower, K.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-8805116—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010528/JAW.

From Symposium on the physics and chemistry of SiO/sub 2/ and the Si-SiO/sub 2/; Atlanta, GA, USA (15 May 1988).

Electron paramagnetic resonance (EPR) measurements indicate that P/sub b/ centers, which are a dangling-bond type of defect at the (111) $Si-SiO_2$ interface, can be passivated with H_2 at a rate which is proportional to the H_2 concentration in the thermal oxides and the interfacial density of P/sub b/ centers. This process is characterized by an activation energy, E/sub f/, of 1.66 {+-} 0.06 eV with a second-order pre-exponential factor, k/sup (2)//sub of/, of 1.94 ({plus}2.-1) {times} 10/sup {minus/6} cm^3sec for temperatures between 230 and 260{degree}C. The passivation process is demonstrated to be consistent with a chemical process in which H_2 molecules, during the course of their duffusional motion among the accesible interstices of the SiO_2 network and the reaction site at P/sub b/ centers, react directly with P/sub b/ centers. EPR measurements indicate that passivated P/sub b/ centers, denoted as HP/sub b/, in effect dissociate in vacuum above 550{degree}C. 18 refs., 5 figs.

36951 (SAND—88-0044C) Light element redistribution and property changes in insulators due to ion bombardment and chemical processing. Arnold, G.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 29p. (CONF-8806145—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011687/JAW.

From 6. international conferene on ion beam modification of materials; Tokyo, Japan (12 Jun 1988).

Ion-implantation into certain classes of insulating materials results in compositional changes due to loss of material from the implanted region. These changes may be accompanied by the incorporation of ambient H. Crystalline $LiNbO_3$ (Li-loss) and alkali-silicate glasses (alkali-loss) are materials which exhibit such changes. In both cases, radiation-enhanced diffusion has been invoked for the heavy-ion losses. The compositional changes in the implanted region of alkali-silicate glasses can bring about phase-separation and crystallization with consequent significant physical property changes. Ion-implantation of H into SiO_2 (glassy and crystalline) has proved useful in determining the number of interstitial sites in these materials and a direct confirmation of indirectly obtained free-volume fraction values.

36952 (SAND—88-0053C) Physical and electrical properties of oxides grown on carbon-implanted silicon. Arnold, G.W.; Schubert, W.K.; Seager, C.H.; Carr, M.J.; Nelson, G.C.; Doyle, B.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-8806152—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011789/JAW.

From Shanghai workshop on characterization of ion implantation in silicon; Shanghai, China (2 Jun 1988).

The effects of C on gate-oxide integrity have been quantified by implanting C into <100> Si and growing an oxide (~ 400 A) which incorporates the C as the Si is consumed. Implants of 10^{12}, 10^{13}, 10^{14}, and 10^{15} 10 keV C (R/sub p/ ~ 40 A) were followed by damage anneals at 800°C, gate oxide growth at 1100°C, and a final 1000°C anneal in N_2/O_2. I-V curves showed significant lowering of breakdown field at fluences as low as $10^{13}/cm^2$ and degradation at $10^{13}/cm^2$. 24 MeV Si elastic recoil detection (ERD), secondary ion mass spectrometry (SIMS), and Auger electron spectroscopy (AES) profiling of C implants showed small accumulations of C by the growing oxide relative to that left in the Si.

36953 (SAND—88-0221C) PECVD of amorphous nickel–phosphorus films. Hays, A.K.; Nelson, G.C.; Seager, C.H. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 2p. (CONF-880383—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88011088/JAW.

From AT and T Task Group V meeting; Albuquerque, NM, USA (22 Mar 1988).

We have developed a plasma deposition technique capable of producing amorphous transition metal-metalloid coatings. The technique consists of decomposing gas mixtures containing transition metal carbonyls and metalloid hydrides in a radiofrequency discharge. Nickel-phosphorus was chosen as a proof-of-principle film for this work. The key to obtaining amorphous metals, as opposed to amorphous metal oxides, lies in the use of a hydrogen carrier gas to remove unwanted oxygen in the form of water as a gaseous by-product. In addition it was discovered that carbon could be completely removed from these films by heating the substrates slightly above room temperatures. 1 ref.

36954 (SAND—88-1131C) Adhesion of hydrated silicate films. Michalske, T.A.; Keefer, K.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880408—24). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011250/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

We used fracture mechanics test techniques to measure the adhesive bond energy formed between hydrated silica glass surfaces and silicate species deposited from solution. In the case of silicate surfaces hydrated in room temperature water vapor, intermolecular bonding between hydrated surfaces can be attributed to either hydrogen bonding interactions between adsorbed water molecules (0.15 Jm^2) or electrostatic bonds formed between adsorbed cations and anionic-nonbridging surface oxygen groups (2.0 Jm^2). The bonding interaction observed at room temperature depends upon the glass surface composition and the degree of surface hydration. When hydrated silicate solution species are added to the interface and heat treated, adhesion energies as large as the cohesive energy of silica glass can be obtained with heat treatments as low as 200{degree}C. The adhesion of the silicate interfacial film produced by the addition of solution species is greatest for silicate precursors showing a low degree of molecular crosslinking. In addition, the presence of alkali in the silicate solution greatly enhances interface adhesion for heat treatments below 200{degree}C. 9 refs., 10 figs.

36955 (SAND—88-1213C) Precursor chemistry and the structure of silica aerogels. Schaefer, D.W.; Brinker, C.J.; Wilcoxon, J.P.; Wu, D.Q.; Phillips, J.; Chu, B. (Sandia National Labs., Albuquerque, NM (USA); State Univ. of New York, Stony Brook (USA). Dept. of Chemistry). 1988. Contract AC04-76DP00789. 5p. (CONF-880408—25). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011253/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

Small-angle X-ray scattering is used to characterize the structure of aerogels prepared by two-stage polymerization processes. Second-stage catalysis controls the resistance to collapse during drying with base-catalyzed system being most resistant. We find the origin of this resistance in the solution precursor chemistry. Base catalysis in the second stage leads to compaction of the polymer network on short length scales. This short-scale rigidity makes the networks sufficiently robust to withstand the surface tension forces present during drying. Aging in solution also improves aerogel quality. In this case, a dissolution-repolymerization process leads to short length scale circuits and improved rigidity. 12 refs., 2 figs.

36956 (SAND—88-1313C) Laser probes and numerical modeling as process diagnostics in chemical vapor deposition. Breiland, W.G.; Ho, P.; Coltrin, M.E.; Kee, R.J.; Evans, G.H. (Sandia National Labs., Albuquerque, NM (USA); Sandia National Labs., Livermore, CA (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880408—26). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011622/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

The chemical vapor deposition process consists of a chemically reacting flow in which the fluid mechanics and chemical kinetics are strongly coupled. Laser probes such as Raman spectroscopy and laser induced fluorescence can be used to measure gas temperature fields and chemical species concentrations, but often the interpretation of such data is difficult because several interacting chemical and physical phenomena are occurring simultaneously. Detailed numerical modeling of the experimental system under study provides valuable insights into these interactions and allows one to make useful comparisons between experiment and the model to gain a fundamental understanding of the CVD process. Examples of this approach are given for silicon deposition from silane and fluid mechanics diagnostics in a rotating disk CVD reactor. 19 refs., 8 figs.

36957 (SAND—88-1453C) Refractory films from spin-cast carbon. Renschler, C.L.; Sylwester, A.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880669—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011251/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

A method is described to produce thin films of carbon by the pyrolysis of spin-cast polyacrylonitrile. Uv, ir, and Raman spectroscopies were employed to investigate the chemical structure of the films during pyrolysis. The electrical conductivity of films made in this way can be varied over several decades by changing the final temperature of carbonization. These films can also be photolithographically patterned and manipulated by wet and dry trans-

fer techniques. As such, these films may have utility in microelectronic and hybrid microcircuit applications. 7 refs., 4 figs.

36958 (SAND—88-1595C) Formation and characterization of inorganic membranes from zeolite-silica microcomposites. Bein, T.; Brown, K.; Enzel, P.; Brinker, C.J. (New Mexico Univ., Albuquerque (USA). Dept. of Chemistry; Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880408—30). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011913/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

Small crystals of zeolites (500-1000 nm) with two- and three-dimensional channel systems (faujasite and ZSM-5 structures) were embedded in amorphous thin films derived from TEOS hydrolyzed in alcoholic solution. Scanning electron microscopy studies show that the zeolites can be quite evenly dispersed in the membrane, resulting in single layers of zeolite crystals protruding out of the amorphous matrix. In situ FT-IR studies with a series of probe molecules revealed that in most membranes the zeolites were 100% accessible from the gas phase. The membranes excluded molecules which are larger than the pore openings of the zeolite embedded in the composite.

36959 (SAND—88-8219) Temperature, moisture, and strain rate effects on the compressive mechanical behavior of Nylon 6/6. Kawahara, W.A.; Brandon, S.L.; Korellis, J.S. (Sandia National Labs., Livermore, CA (USA)). Apr 1988. Contract AC04-76DP00789. 35p. NTIS, PC A03;3. Order Number DE88010734/JAW.

Material test results are presented for the mechanical behavior of Nylon 66 in compression. Static compression modes include direct compression, stress relaxation and creep. Dynamic direct compression results are included. Tests are performed at atmospheric pressure; strain rates range from 10/sup {minus/4}sec to 10^2sec; temperatures are 20, 65, 110, 150 and 200{degree}C; moisture levels are 0% (dry), 2% and 6% (saturated); true strains to {minus}0.25 are imposed. Our empirical Temperature-Moisture equivalence of 14{degree}C per 1% moisture is discussed with respect to the {open‹–quotes}free volume{close‹–quotes} concept.

36960 (SVF—252) Study of existing and expected materials problems in steam power plants. Poturaj, S.; Groenwall, B.; Haeggblom, E. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Feb 1987. 51p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752980/JAW.

The present work comprises three parts: - Materials problems and thereby caused failures in Swedish steam power plants which have been overviewed by questionnaire, - an evaluation of the causes of the corrosion damages of the austenitic superheater tubes at Hallstavik paper mill, - a study of materials selection in foreign power plants, especially plants with high steam conditions. The failures concern all steps from fuel feeding and damages in the furnace, to exhaust gas fans. In Hallstavik, stress corrosion cracking has occurred in the austenitic 16Cr13Ni1Nb austenitic superheater tubes. The cracking was caused by residual stresses in cold worked bends combined with a water containing chloride. From the materials selection study, it is concluded that technology today exists to build a pulverized coal power plant with double reheat steam conditions up to 310 bar and 565 degrees C. (authors).

36961 (UCID—21349) Optical coatings for high average power XeF lasers: Final report. Milam, D.; Thomas, I.; Wilder, J.; George, D. (Lawrence Livermore National Lab., CA (USA)). 16 Mar 1988. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011356/JAW.

Porous silica, calcium and magnesium fluorides were investigated for potential use as antireflective coatings for XeF lasers. Excellent optical properties were obtained for all types, and laser damage thresholds were in the range 18-25 Jcm^2 at 350 nm for 25 ns pulses at 25 Hz pulse repetition frequency. Studies of the effects of the XeF laser environment on these coatings were incomplete. Three oxides, ZrO_2, HfO_2, and Ta_2O_5 were investigated as the high index components to be paired with low index porous SiO_2 for highly reflective dielectric coatings. Single oxide layers had indices in the 1.7-1.8 range and HfO_2 coatings had the highest damage threshold at about 5 Jcm^2. An unexpected problem arose on attempts to prepare multilayer coatings. Stress in the coating after 6-8 layers had been put down, gave rise to crazing and peeling. This could not be avoided even on extending the curing process between coats.

36962 (UCRL—97598) Improved adhesion for SiO_2 particles in silica substrates using helium-ion irradiation. Musket, R.G.; Thomas, I.M. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 6p. (CONF-880408—14). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008915/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

We have examined the effects of irradiation with 200-keV helium ions on the adhesion and optical transmission properties of 220 nm thick antireflective, optical coatings that consisted of layers of spherical, 20 nm diameter silica particles. In the as-deposited state these sol-gel coatings have very low adhesion to the fused silica subtrates. Results for adhesion and optical transmission have been obtained for doses of 10^{15}-10^{17} $Hecm^2$. Significant improvement in adhesion was found for doses exceeding about 2 {times} 10^{14} $Hecm^2$. Optical transmission measurements for wavelengths of 200-1200 nm showed increasing absorption with dose. We have evidence that the helium ions decompose various contaminants in the coating into two types of degradation products. One is volatile and the other remains in the coating as optically absorbing species. UVoxidative-gas treatment effectively removes the absorbing species.

36963 (UCRL—97773) A molecular view of bulk deformation. Cook, R. (Lawrence Livermore National Lab., CA (USA)). 20 Nov 1987. Contract W-7405-ENG-48. 10p. (CONF-8806139—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011344/JAW.

From Symposium on computer applications in applied polymer science; Toronto, Canada (5 Jun 1988).

In the work reported here, we have examined the conformational geometry and energetics associated with the gauche to trans transition in polymer chains by examining the extension of a four atom chain orginally in a gauche configuration, as well as six and eight atom chains in tgt and ttgtt configurations, respectively. We have examined these systems with constraining force constant, γ/ sub c/, that varies from zero to values high enough to suppress almost all translational motion normal to the chain direction, effectively eliminating the torsional gauche to trans motion. Our particular interest is in energy storage, thus we have followed the energy stored in the bond lengths, backbone bond angles and torsional angles as a function of chain extension and the magnitude of the constraining force. 7 refs., 2 figs.

36964 (UCRL—97912) Observations made during stretching, tearing and failure of NR [natural rubber] and SBR [styrene-butadiene rubber] loaded with various amounts of carbon black. Goldberg, A.; Lesuer, D.R.; Patt, J. (Lawrence Livermore National Lab., CA (USA); Army Tank-Automotive Command, Warren, MI (USA)). 1 Feb 1988. Contract W-7405-ENG-48. 27p. (CONF-880480—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008030/JAW.

From Severe environment symposium; Dallas, TX, USA (19 Apr 1988).

In order to effectively utilize fractography as an aid in identifying the influence of material and service (or test) parameters on material properties, one must first understand the origin of the morphological features developed during the tearing and fracturing of these elastomers. At our laboratory, we have made extensive fractographic studies while evaluating the effects of material formulations, temperature, and loading rates on the loading response, tearing energy, induced damage, and tearing phenomena in SBR (Styrene Butadiene Rubber) containing different amounts of CB (Carbon Black) filler. We have also examined failures in tank track pads, as well as laboratory-tested samples cut from new track pads. In this paper we report on observations made during the actual

stretching, tearing and failure of elastomeric samples pulled in tension at a constraint stroke-diplacement rate. 15 refs., 12 figs.

36965 Thermodynamic properties and equation of state of dense fluid nitrogen. Belak, J.; Etters, R.D.; LeSar, R. (Physics Department, Colorado State University, Fort Collins, Colorado 80523). *Journal of Chemical Physics;* **89**: No. 3, 1625-1633(1 Aug 1988).

Results of constant-pressure Monte Carlo calculations on dense fluid nitrogen over a pressure range of 2 to 300 kbar and a temperature range of 300—3000 K are presented. From analytic fits to the calculated volumes, enthalpies and vibrational frequency shifts, a comprehensive set of thermodynamic quantities is derived, including: thermal expansivity, compressibility, specific heat, Grueneisen parameter, and speed of sound. Comparison of the theoretical results to experiment at room temperature shows very good agreement (within 0.3% in volume and 1% in speed of sound, for instance). Good agreement is also obtained with earlier simulation data. In agreement with experimental studies of fluid metals, we find that the speed of sound varies linearly with density; along isotherms as well as along the Hugoniot. We find that rhoγ/sub G/ , the density times the Grueneisen parameter, which is assumed to be a constant in an often-used phenomenological equation of state, varies considerably with density and temperature. Comparison is made with results from a "soft sphere" model presented in an accompanying paper.

36966 Photoluminescence and the band structure of InAsSb strained-layer superlattices. Kurtz, S.R.; Osbourn, G.C.; Biefeld, R.M.; Lee, S.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **53**: No. 3, 216-218(18 Jul 1988).

Infrared photoluminescence measurements were performed on InAs/sub 0.13/Sb/sub 0.87/ /InSb strained-layer superlattices. In thick layered structures we observed very low energy transitions proving that a type II superlattice occurs in the InAsSb system. Band structures were calculated based on estimates of the band offsets and strain shifts obtained from the photoluminescence data.

36967 Minority-carrier properties of GaAs on silicon. Ahrenkiel, R.K.; Al-Jassim, M.M.; Dunlavy, D.J.; Jones, K.M.; Vernon, S.M.; Tobin, S.P.; Haven, V.E. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **53**: No. 3, 222-224(18 Jul 1988).

The minority-carrier lifetimes of the heteroepitaxial system of GaAs on Si are limited by recombination at mismatch dislocations. Here we show that increasing the thickness of the buffer layer, with an additional annealing step, reduces the dislocation density by about an order of magnitude. At the same time, the minority-carrier lifetime in these double heterostructures increases more than an order of magnitude.

36968 Effects of high carbon concentration upon oxygen precipitation and related phenomena in CzSi. Hahn, S.; Arst, M.; Ritz, K.N.; Shatas, S.; Stein, H.J.; Rek, Z.U.; Tiller, W.A. (Siltec Corporation, 190 Independence Drive, Menlo Park, California 94025). *Journal of Applied Physics;* **64**: No. 2, 849-855(15 Jul 1988).

Effects of high carbon concentration upon oxygen precipitation and related phenomena in Czochralski (Cz) silicon have been investigated by combining various furnace and rapid thermal anneals. Our data show that oxide precipitate (OP) density, estimated from changes in interstitial oxygen concentration (ΔO/sub i/), increases with increasing substitutional carbon concentration, C/sub s/, while thermal donor (TD) formation is inhibited at high C/sub s/. Even though ΔO/sub i/ increases monotonically with C/sub s/, synchrotron radiation section topographs of processed high carbon content wafers (C/sub s/∼4 ppma) exhibit Pendelloesung fringes, indicating a strain-free bulk state. Our transmission electron microscope and optical microscopic data also show very few resolvable structural defects associated with precipitates inside the bulk Si. Using a thermodynamic and kinetic model, we attempt to explain: (1) reduced thermal donor formation, (2) lack of bulk stress notwithstanding high ΔO/sub i/, and (3) predominantly polyhedral precipitate morphologies in high carbon content CzSi.

36969 Sensitivity of diffusion length determination on background current collection efficiency in light beam induced current analysis using the Zook equation. Field, H.; Ast, D. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14853). *Journal of Applied Physics;* **64**: No. 2, 955-956(15 Jul 1988).

The fall-off of the light beam induced current in the vicinity of a grain boundary is frequently used to determine the minority-carrier diffusion length in the vicinity of the boundary and the surface recombination velocity at the boundary. It is shown that the numerical values obtained can be very sensitive to the choice of the background.

36970 High-pressure neutron-scattering studies of graphite and stage-two graphite-$SbCl_5$. Alzyab, B.; Perry, C.H.; Zahopoulos, C.; Pringle, O.A.; Nicklow, R.M. (Physics Department, Northeastern University, Boston, Massachusetts 02115). *Physical Review [Section] B: Condensed Matter;* **38**: No. 2, 1544-1547(15 Jul 1988).

The longitudinal-acoustic (LA) phonons propagating along the c axis in highly oriented pyrolytic graphite (HOPG) were investigated as a function of pressure up to 20 kbar using inelastic-neutron-scattering techniques. The phonon frequencies varied as $\nu(P,q) = A(P)\sin[c(P)q/2]$, where A(P) and c(P) indicate the pressure dependences of the zone-center LO frequency of B_1/sub g// sub >1/ symmetry and of the c-axis lattice spacing, respectively. From the measurements, the mode Grueneisen parameter for the LA branch was estimated to be 1.5 x 10/sup -2/ kbar/sup -1/ (independent of q); the elastic constant C/sub 33/ for HOPG was found to be 3.40 x 10/sup 11/ dyn/cm^2 at 1 bar with a pressure coefficient of (1/C/sub 33/)(dC/sub 33//dP) = 2.91 x 10/sup -2/ kbar/sup -1/. The measured c-axis spacings were 6.71 and 12.72 A for HOPG and stage-2 $SbCl_5$-intercalated graphite, respectively, at atmospheric pressure; the corresponding compressibilities (1/c)(dc/dP) were -2.24 x 10/sup -3/ kbar/sup -1/ (HOPG) and -2.28 x 10/sup -3/ kbar/sup -1/ ($SbCl_5$). Elastic-neutron-scattering studies up to 20 kbar were undertaken to search for stage transformations, but no evidence of any phase transition was observed.

36971 Work hardening and strain relaxation in strained-layer buffers. Dodson, B.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Applied Physics Letters;* **53**: No. 1, 37-38(4 Jul 1988).

Fully relaxed buffer layers are of considerable importance for growth of high quality crystals on substrates having different lattice parameters. Recent experiments by Biefeld et al. [R. M. Biefeld, C. R. Hills, and S. R. Lee, J. Cryst. Growth (in press)] in the InAsSb system show that the degree of relaxation is considerably less than expected using conventional equilibrium models, but is more complete in continuously graded than in step-graded buffer layers. In the present letter, this observation is explained in terms of Taylor-type (dislocation interaction) work hardening.

36972 Thermodynamics of isotopic polymer mixtures: Significance of local structural symmetry. Bates, F.S.; Muthukumar, M.; Wignall, G.D.; Fetters, L.J. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Journal of Chemical Physics;* **89**: No. 1, 535-544(1 Jul 1988).

The dependence on composition (Phi) and degree of polymerization (N) of the effective segment—segment interaction parameter, chi-tilde = - 1/2 partial$^2\Gamma$/partialPhi^2, has been determined for mixtures of perdeuterated and normal (protonated) poly(vinylethylene) and poly(ethylethylene) by small angle neutron scattering (SANS), where Γ represents the excess free energy of mixing. Owing to the small reduction in length and polarizability of carbon—hydrogen bonds with deuterium substitution, isotopic polymer mixtures are characterized by small positive chi-tilde parameters. However, deuterium substitution does not significantly influence the local structural symmetry (i.e., the liquid structure or reduced thermodynamic properties) of polymer isotopes, consistent with the assumptions of Flory—Huggins (FH) lattice theory. Nevertheless, we find that chi-tilde depends significantly on both Phi and N, contrary to the predictions of FH theory. A general theory, which corrects FH theory for monomer concentration fluctuations, is shown to closely account for these experimental results. In un-

derstanding the previous experimental investigations of chi-tilde for mixing chemically different species, the monomer concentration fluctuations discussed here must be addressed in addition to the effects due to local structural asymmetry.

36973 **Intrachain flexibility constraints on phase stabilities and odd-even effects in multiple smectic-A and nematic liquid crystals.** Dowell, F. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 1, 382-394(1 Jul 1988).

The importance of the flexibility of n-alkyl tail chains in real liquid-crystal systems is reviewed. Two new microscopic, molecular statistical-physics theories (a full statistical theory and a simpler but accurate approximate theory) for the intrachain constraints on the n-alkyl tail-chain flexibility are presented and are compared with each other and with an old, more approximate theory for tail-chain flexibility used in earlier papers. The new approximate approach is computationally much faster than the full statistical method and is the first treatment to generate and explain odd-even effects in multiple smectic-A phases and the first treatment to generate and explain odd-even effects in smectic-A and nematic phases without resorting to ad hoc or arbitrarily adjustable fits to experimental data. Phase stabilities and odd-even effects for various thermodynamic and molecular ordering properties are calculated in the smectic-A_1, smectic-A/sub d/, and nematic liquid-crystal phases and the isotropic liquid phase using the new approximate method. Some predictions and accompanying physical explanations are made for various systems that have not yet been chemically synthesized and/or experimentally studied.

36974 **Electron motion in the gases CF_4, C_2F_6, C_3F_8, and n-C_4F/sub 10/.** Hunter, S.R.; Carter, J.G.; Christophorou, L.G. (Atomic, Molecular and High Voltage Physics Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] A: General Physics;* **38**: No. 1, 58-69(1 Jul 1988).

The drift velocity w of electrons has been measured in the perfluoroalkanes n-C/sub N/F_2/sub N//sub +2/ (N = 1—4) over the density-reduced electric field (E/N) range 0.03 x 10/sup -17/ V $cm^2 \leqq E/N \leqq 500$ x 10/sup -17/ V cm^2 using a pulsed Townsend experimental method. The present measurements of w are the first to be obtained for C_2F_6, C_3F_8, and n-C_4F/sub 10/ at low E/N values. The electron-drift-velocity measurements in C_3F_8 and n-C_4F/sub 10/ are dependent on gas pressure at high E/N values, even after allowing for nonequilibrium and boundary corrections to the measured electron swarm transit time. This is the first observation of a pressure dependence in the electron drift velocity in these gases and is believed to be due to changes in the electron energy distribution function f(epsilon-c,E/N) with gas pressure resulting from increases in the density-normalized electron attachment coefficient eta/N with gas pressure. The perfluoroalkanes CF_4, C_2F_6, and C_3F_8 exhibit regions of pronounced negative differential conductivity (NDC) similar to but smaller in magnitude than that in CH_4. Possible mechanisms leading to the observation of NDC effects in these molecular gases are discussed.

36975 **Analytical and numerical modeling of columnar evolution in thin films.** Srolovitz, D.J.; Mazor, A.; Bukiet, B.G. (Department of Materials Science and Engineering, University of Michigan, Ann Arbor, Michigan 48109). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 4, 2371-2380(Jul 1988).

A theory for the growth of columnar microstructure in thin films is presented. The zone II columnar microstructure is shown to result from a balance between shadowing (which results in zone I microstructures) and surface diffusion (which tends to smooth the surface). The zone I to zone II transition temperature is predicted together with the type of unstable modes. The surface morphology and the columnar grain structure are obtained both analytically and numerically. The scaling behavior of the grain size with film thickness is derived. Monte Carlo computer simulations follow the temporal evolution of three-dimensional zone II microstructures, and account for growth competition between adjacent grains, and the formation of film texture. These results agree with experimental data.

36976 **Structure and properties of sputtered carbon overcoats on rigid magnetic media disks.** Tsai, H.; Bogy, D.B.; Kundmann, M.K.; Veirs, D.K.; Hilton, M.R.; Mayer, S.T. (Department of Mechanical Engineering, University of California, Berkeley, California 94720). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 4, 2307-2315(Jul 1988).

Sputtered carbon overcoats on commercial rigid disks with thin-film magnetic media are studied using transmission electron analysis (microscopy, microdiffraction, and energy-loss spectroscopy), Raman spectroscopy, Auger spectroscopy, ellipsometry, x-ray diffraction, and microhardness testing. Data from transmission electron analysis, Raman spectroscopy, and ellipsometry suggest that the carbon overcoats are composed of small graphite crystallites ($\leqq$2 nm), randomly oriented, with a small percentage (0%—5%) of fourfold coordinated carbon bonds. Auger spectroscopy and transmission electron energy-loss spectroscopy indicate the presence of a small amount of oxygen. Auger spectroscopy also shows some surface nitrogen. The optical constants, n = 2.1 and k = 0.78, exhibit a small wavelength dependence. In addition, the extinction coefficient k shows a dependence upon film thickness. X-ray diffraction and microhardness testing did not yield any information concerning the carbon overcoats. There was no indication of diamond from any of the techniques which distinguish between diamond and other forms of carbon. Differences in structure and bonding are seen with Raman spectroscopy in samples from different manufacturers and in annealed samples.

36977 **Sudden and adiabatic polarization effects in doped rare gases.** Koehler, A.M.; Saile, V.; Reininger, R.; Findley, G.L. (Hamburger Synchrotronstrahlungslabor (HASYLAB), Deutsches Elektronen-Synchrotron (DESY), D-2000 Hamburg 52, Federal Republic of Germany). *Physical Review Letters;* **60**: No. 26, 2727-2730(27 Jun 1988).

The evolution of both the sudden and adiabatic polarization energies resulting from a rare gas interacting with a dopant ion was followed for the first time. The variation of these two polarization energies was determined by means of photoabsorption and photoionization up to rare-gas number densities of (23.0, 24.0, 11.3, and 6.6) x 10^{20} cm^{-3} for He, Ne, Ar, and Kr, respectively. Both polarization energies were found to vary linearly with rare-gas number density. However, the slopes differ by more than 1 order of magnitude. This difference is explained in terms of a model which accounts for the different time scales of the two experiments.

36978 **Effect of thermal blooming on pulse propagation through vaporizing aerosols.** Chitanvis, S.M.; Zardecki, A. (Los Alamos National Laboratory, Theoretical Division, Los Alamos, New Mexico 87545). *Applied Optics;* **27**: No. 12, 2495-2501(15 Jun 1988).

The effect of thermal blooming in the air is formulated within the framework of the radiative transfer equation. This is accompliahed on the basis of the ray optics approach and the notion of an effective time-dependent absorption coefficient that describes the changes in the phase of the electric field caused by thermal blooming. In this approach, the beam spreading effects are entirely due to scattering from the aerosol cloud; the effect of vaporization of aerosols leads to nonlinear coupling of the aerosols to radiation. The general setup is used to model numerically the propagation of a high energy laser beam through a cloud of aerosols distributed in the atmosphere. The limitations of the approach are outlined.

36979 **Supercooling and nucleation of silicon after laser melting.** Stiffler, S.R.; Thompson, M.O.; Peercy, P.S. (Department of Materials Science, Cornell University, Ithaca, New York 14853). *Physical Review Letters;* **60**: No. 24, 2519-2522(13 Jun 1988).

Bulk nucleation of crystalline Si at a supercooling of 505 K was observed following pulsed-laser—induced melting of thin films. If the nucleation was homogeneous, the estimated nucleation rate of 10^{30} eventsm^3 s implies a liquid-Si—crystalline-Si interfacial energy of 0.45 +- 0.02 Jm^2. In addition, observation of crystalline nucleation bounds the interface energy between amorphous Si and liquid Si to be >0.20 Jm^2. This laser melting technique is applicable to nucleation studies in a wide variety of materials.

36980 Ferromagnetism in molecular materials: Decamethylferrocenium tetracyanoethanide (DMeFc) (TCNE) (invited). Epstein, A.J.; Chittipeddi, S.; Chakraborty, A.; Miller, J.S. (Department of Physics and Department of Chemistry, The Ohio State University, Columbus, Ohio 43210-1106). *Journal of Applied Physics;* **63**: No. 8, 2952-2956(15 Apr 1988).

Ferromagnetism has only recently been observed in molecular materials. We present here a summary of the ferromagnetic phenomena observed in the molecular charge transfer salt, decamethylferrocenium tetracyanoethanide (DMeFc)(TCNE), and related compounds. A spontaneous magnetization is observed in this material for T<4.8 K, with a saturation moment in agreement with alignment of individual spins localized on the $DMeFc^{+}$/sup x/ and $TCNE^{-}$/sup x/ ions. A comparison of these results with analogous charge transfer salts is presented. Models for the magnetic interaction in the charge transfer salts and the preparation of other molecular and/or polymeric materials with ferromagnetic exchange are presented.

36981 Semiconductor junction formation by directed heat. Campbell, R.B. (to Dept. of Energy, Washington, DC). US Patent 4,729,962. 8 Mar 1988. Filed date 24 Mar 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

The method of forming semiconductor junctions in a dendritic silicon web of either P- or N-type is described comprising: applying a single coating of a liquid precursor solvent containing a dopant of a type opposite that of the web to one face of the web; applying a single coating of a liquid precursory solvent containing a dopant of a type the same as that of the web to the opposite face of the web; then baking the web in an oven at approximately 200°C for approximately 20 minutes to remove excessive solvent; then heating the web rapidly with a high intensity light for a period in the range of 15 seconds to attain temperatures in a range from about 950°C to 1200°C to simultaneously form junctions in both faces of the web; and then annealing the web in air following the rapid heating.

36982 Shear-lag analysis of fiber push-out (indentation) tests for estimating interfacial friction stress in ceramic-matrix composites. Shetty, D.K. (Dept. of Materials Science and Engineering, Univ. of Utah, Salt Lake City, UT (US)). *Journal of the American Ceramic Society;* **71**: No. 2, C-107-C-109(Feb 1988).

A shear-lag analysis is presented for estimating sliding friction stress at fiber-matrix interfaces in ceramic-matrix composites using the single-fiber push-out test. The analysis includes an approximate correction for the increased interfacial compression and, therefore, the interfacial friction stress arising from the transverse (Poisson) expansion of the fibers subjected to the compressive load. An exponential decrease of the interfacial shear stress along the fiber length is predicted. This result is similar to the results of a finite-element analysis reported in the literature. The analysis also provides a basis for the experimental determination of a coefficient of interfacial friction (μ) and a residual interfacial compression (σ/sub O/). It is shown that the sliding friction stress (tau/sub f/ $=\mu\sigma$/sub O/) can be overestimated if the transverse expansion of the fibers is not taken into account.

36983 Transient radiation effects in SOI static RAM cells. Mikawa, R.E.; Ackerman, M.R. (Sandia National Labs., Albuquerque, NM 87185 (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1698-1703(Dec 1987). (CONF-8707112—). Contract AC04-76DP00789.

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

Recent transient radiation experiments have shown a substrate bias dependence on the logic upset levels of a silicon-on-insulator (SOI) technology. From this data, it was concluded that secondary photocurrents generated by the parasitic bipolar junction transistors (BJTs) were responsible for the observed difference in the bias dependent transient radiation induced upset thresholds. In this report we present our results obtained from computer simulations of the transient radiation response of the SOI technology. These results support a possible explanation for the bias dependent logic upset levels experimentally observed. Parasitic BJT gain calculations, gain modulation and substrate bias effects on transient upset thresholds in static random access memory (SRAM) cells are discussed.

36984 A programmable test system for transient annealing characterization of irradiated MOSFETS. Tausch, H.J.; Wemhoner, R.; Pease, R.L.; Schwank, J.R.; Maier, R.J. (Design Engineering Inc., 4725 Lumber Avenue NE., Suite 1, Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1763-1768(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

A current programmable, computer controlled Transient Annealing Test System (TATS) for making complete MOSFET I-V measurements is described. The system forces source currents from 100 pA to 10 mA and measure corresponding gate voltages starting at times as early as 100 μs after a radiation pulse. Features of the system include multiple independent test channels, temperature control over the full military range and completely programmable test/bias sequences. Applications of the system include: a) transient failure mechanism studies, b) in-source testing, and c) high throughput wafer level hardness assurance testing.

36985 Radiation-tolerant, sidewall-hardened SOI/MOS transistors. Tsao, S.S.; Fleetwood, D.M.; Weaver, H.T.; Pfeiffer, L.; Celler, G.K. (Sandia National Labs., Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1686-1691(Dec 1987). (CONF-8707112—). Contract AC04-76DP00789.

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

Total dose radiation effects were measured for sidewall-hardened n-channel SOI/MOS transistors, fabricated in zone-melt-recrystallized (ZMR) and oxygen-implanted (SIMOX) SOI materials. The authors compare the radiation responses of transistors with three types of sidewall or edge configurations: island transistors with passivated edges, island transistors without passivated edges, and edgeless (enclosed-gate) transistors. Data from these three test devices allow clear separation of front-, back-, and edge-channel conduction. Passivated edge channels were hard to Co-60 doses in excess of 24 Mrad(Si). The overall hardness of the passivated-edge transistors is limited only by the radiation-induced threshold voltage shifts (about -1 V at 1.0 Mrad) of the top channel. No significant differences in total-dose response of ZMR and SIMOX devices were observed under the radiation conditions employed.

36986 Picosecond studies of the nonradiative decay dynamics of triphenylmethane dyes in a diamond anvil pressure cell. Ben-Amotz, D.; Harris, C.B.; Jeanbz, R. (Exxon Research and Engineering Co., Annandale, NJ 08801 (US)). pp 106 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper WFF 2.

The nonradiative decay dynamics of crystal violet and other triphenylmethane dyes depend strongly on the nature of the solvent in which they are dissolved. The rate-limiting step of the decay is thought to be barrierless torsional diffusion of the phenyl groups in the excited electronic state. Previous studies of either the fluorescence quantum yield or the ground state bleach recovery time have found a weak nonlinear viscosity dependence. Recent studies of the excited-state absorption decay time have found a linear viscosity dependence in the eta-alcohol series of solvents at constant temperature. The results of the first pressure-dependent picosecond study of a triphenylmethane dye in short chain alcohols are reported. This study reveals a linear viscosity dependence over a viscosity range of nearly three decades. Differences between the temperature, pressure, and solvent dependence at low viscosities are discussed.

36987 Growth and characterization of GaAs/AlAs superlattice alloys. Drummond, T.J.; Jones, E.D.; Hjalmarson, H.P.; Doyle, B.L. (Sandia National Labs., Albuquerque, NM (US)). pp 2-9 of Growth of compound semiconductors. Gunshor, R.L.; Morkoc, H. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870385—). Contract AC04-76DP00789.

From SPIE conference on growth of compound semiconductors; Bay Point, FL, USA (26 Mar 1987).

Recent studies of short period GaAsAlAs superlattices grown by molecular beam epitaxy have shown thats the superlattice bandstructure resembles that of the AlGaAs alloy system. The authors have studied indirect gap GaAsAlAs superlattice alloys using x-ray diffraction and pressure dependent magneto-luminescence. Analysis of the x-ray data shows that the AlAs layers are strained to be pseudomorphic with the GaAs substrate. Because the indirect conduction band ground state derives from the AlAs X-point these superlattice alloys must be treated as trained-layer superlattices. Interpretation of luminescence data using Kronig-Penney and tight-binding analyses of the superlattice bandstructure and optical dipole matrix elements shows that this experiment provides a sensitive measure of the conduction band offset for the GaAsAlAs system. Quantum size effects lift the three-fold degeneracy of the X-point to yield an in-plane X band quantized according to the transverse electron mass (X/sub t/) and a separate X band along the superlattice axis quantized according to the longitudinal electron mass (X/sub t/). Strain shifts at the X-points are of the same magnitude as quantum size effect shifts and drive the X/sub t/ band toward lower energies. The effect of strain in the conduction band can be accurately modeled by assuming GaP deformation potentials for the AlAs layers.

36988 Molecular dynamics simulation of beam deposition of low-energy (10-100 eV) Si atoms on the Si(111) surface. Dodson, B.W.; Taylor, P.A. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)). pp 130-138 of Growth of compound semiconductors. Gunshor, R.L.; Morkoc, H. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870385—). Contract AC04-76DP00789.

From SPIE conference on growth of compound semiconductors; Bay Point, FL, USA (26 Mar 1987).

The deposition of low energy (10-100 eV) silicon atoms onto an unreconstructed (111) silicon surface has been studied using molecular dynamics techniques and an accurate empirical potential describing the covalent Si-Si bonding. 10 eV silicon atoms were directed normal and at 60° angles to a silicon (111) substrate. The resulting atomic trajectories and substrate response were studied to determine the energy loss mechanism resulting in capture and the local lattice excitation near, and subsequent diffusion of excess vibrational energy away from, the impact point. More glancing angles of incidence (5° - 30°) were studied for beam energies of 20-100 eV. In general, incident atoms are either quickly adsorbed or scatter from the surface in this energy range. However, for angles less than a critical value a new phenomenon of 'surface channeling' is observed. In 'surface channeling', the trajectory of the incoming particle is steered by short-range repulsive and long-range attractive interactions with the surface atoms parallel to, and roughly 2 A above, the surface of the substrate. Ranges of thousands of angstroms of travel along the surface can occur before the particle ultimately undergoes adsorption into a single site. These surface channeling trajectories as well as the local excitation provided by adsorption of energetic incident atoms offer considerable promise for precision control of the beam-induced growth and non-equilibrium semiconductor structures.

36989 Multiphase flow in geological materials: Dynamic loading theory and numerical modelling. Kansa, E.J.; Kirk, T.M.; Swift, R.P. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA (US)). pp 206-211 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemical Engineers (1987). (CONF-870816—). Contract W-7405-ENG-48.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The authors have developed a numerical scheme for integrating the time-dependent conservation equations for multifluid porous flow. One of its features is as an explicit-implicit method for integrating that constituent momentum equations which only involves a block diagonal matrix. The equations are solved in a Lagrangian frame tied to the solid particle velocity. In this frame, they are able to time-integrate the liquid and gaseous mass conservations exactly. They demonstrated the solution technique on a 2- and 3-phase porous flow shock tube simulation. The saturated case agrees well with the previous results of Garg and Sandhu. The authors successfully run the unsaturated case at both high and low permeability. The gas phase response, because of small inertia, is basically uncoupled from that of the solid and liquid. The unsaturated case also permits gas, "air", to be transported in or out of pores very readily as compared to water which has so much more inertia.

36990 Enstatite, $Mg_2Si_2O_6$: A neutron diffraction refinement of the crystal structure and a rigid-body analysis of the thermal vibration. Ghose, S.; Schomaker, V.; McMullan, R.K. (Washington Univ., Seattle (USA). Dept. of Geology; Washington Univ., Seattle (USA). Dept. of Chemistry; Brookhaven National Lab., Upton, NY (USA). Dept. of Chemistry). *Zeitschrift fuer Kristallographie, Kristallgeometrie, Kristallphysik, Kristallchemie;* 176: No. 3/4, 159-175(1986). Contract AC02-76CH00016.

Synthetic enstatite, $Mg_2Si_2O_6$, is orthorhombic, space group Pbca, with eight formula units per cell and lattice parameters a = 18.235(3), b = 8.818(1), c = 5.179(1) A at 23°C. A least-squares structure refinement based on 1790 neutron intensity data converged with an agreement factor $R(F^2) = 0.032$, yielding Mg-O and Si-O bond lengths with standard deviations of 0.0007 and 0.0008 A, respectively. The variations observed in the Si-O bond lengths within the silicate tetrahedra A and B are caused by the differences in primary coordination of the oxygen atoms and the proximity of the magnesium ions to the silicon atoms. The latter effect is most pronounced for the bridging bonds of tetrahedron. A. The smallest O-Si-O angle is the result of edge-sharing by the Mg(2) octahedron and the A tetrahedron. An analysis of rigid-body thermal vibrations of the two crystallographically independent $[SiO_4]$ tetrahedra indicates considerable librational motion, leading to a thermal correction of apparent Si-O bond lengths as large as +0.002 A at room temperature.

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REFER ALSO TO CITATION(S) 38514

36991 (CONF-880543—2) Theoretical studies of chemical reactions: potential surfaces. Dunning, T.H. Jr.; Harding, L.B.; Shepard, R.; Cremer, E.; Jasien, P.G. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011984/JAW.

From Basic energy sciences combustion contractor's meeting; Lake Geneva, WI, USA (31 May 1988).

Calculations on the addition reaction of two hydroxyl radicals forming hydrogen peroxide are presented. An analytic representation of the long range surface was obtained by fitting the energies of 1000 points to a potential involving approximately 500 terms. The analytic potential covers the region of the potential surface from an O-O separation of 2.5 A out to two isolated OH radicals. This connects regions where electrostatic, hydrogen bonding and covalent bonding forces each, in turn, dominant the potential and will allow the detailed modeling of the addition reaction in a much more realistic manner than has here-to-fore been possible.

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 35722, 35722, 35742, 35807, 35887, 35900, 35903, 35980, 36181, 36836, 36867, 37202, 37223, 37228, 37229, 37354, 37581, 37718, 37741, 37792, 37807, 37809, 37857, 38154, 38317, 39041

36892 (CEA-N—2541) Method of evaluating quantities of plutonium by gamma spectrometry applied to measurement of retention monitoring of wastes and surveillance of facility dismantling. Morel, J.; Chauvenet, B.; Etcheverry, M.; Monier, J.; Labernede, Y.; Louppe, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Lab. de Metrologie des Rayonnements Ionisants; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Technique). Nov 1987. 22p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753474/JAW.

The gamma spectrometry method of measuring quantities of plutonium has now been developed in different fields of nuclear work to enable reliable balance management to be carried out, to ensure safety requirements are met and to make better discharge monitoring possible. The method is applicable to the measurement of masses ranging from a few tens of milligrammes to a number of tens of grammes, and can replace or back-up other non-destructive techniques. It is comparatively rapid, as a counting period of ten minutes is sufficient for a quantity of the order of one gramme, and requires a gamma spectrometry system previously calibrated in the 100 to 500 keV region. A number of testing sessions have been carried out in the last few months. The results of gamma spectrometry measurement broadly correspond to the calibration values or those derived by other methods: neutron counting and calorimetry.

36893 (CONF-870524—3) Interim: selected chemical research reported between conferences five and six. Jolley, R.L.; Johnson, J.D. (Oak Ridge National Lab., TN (USA); North Carolina Univ., Chapel Hill (USA)). 1987. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011840/JAW.

From 6. conference on water chlorination: environmental impact and health effects; Oak Ridge, TN, USA (3 May 1987).

In this brief literature review, the authors attempt to summarize the principals research that was published in the interval between the fifth and sixth water chlorination conferences (1984-1987) and that is not specifically presented in this volume. Any review is, of necessity, subjective. However, the review should help ensure the comprehensive nature and utility of this collective volume. This review is divided into major groupings and proceeds from that area of chemistry that is a fundamental basis for most science (i.e., analytical chemistry) and progresses to areas of human health and environmental concerns.

36894 (CONF-871038—12) Thermodynamic modeling of chemical equilibria in metal extraction. Chaiko, D.J.; Fredrickson, D.R.; Reichley-Yinger, L.; Vandegrift, G.F. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009948/JAW.

From 5. symposium on separation science and technology for energy application; Knoxville, TN, USA (26 Oct 1987).

Models of equilibrium extraction data are being developed for use in computer simulations of metal extraction processes. The correlations are based on chemical mass action principles in which the effects of metal complexation and aqueous phase activity coefficients are considered. Activity coefficients in mixed electrolyte solutions at high ionic strengths are calculated using methods available in the literature. This modeling approach is demonstrated for HNO_3 extraction with both the PIREX and TRUEX solvents and for Am^{3+} extraction by octylphenyl-N,N-diisobutylcarbamoylmethylphosphine oxide, which is the primary extractant in the TRUEX solvent. 27 refs., 4 figs., 4 tabs.

36895 (CONF-880625—2) On S_2F_{10} formation in spark breakdown of SF_6. Sauers, I.; Votaw, P.C.; Griffin, G.D.; Kurka, K.; Easterly, C.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008088/JAW.

From Institute of Electrical and Electronics Engineers symposium on electrical insulation; Boston, MA, USA (5 Jun 1988).

Recent biological testing [1] of sparked SF_6 has yielded results that implicate the existence of S_2F_{10} in the sparked gas and suggest that S_2F_{10} may play an important role in the over-all toxicity of sparked SF_6. Additionally, experiments on heated sparked SF_6 and direct biological testing of S_2F_{10} have strengthened the above claims. We report on the gas chromatographic (GC) analyses of sparked SF_6 and the comparison with the analyses of 0.5% $S_2F_{10}SF_6$ mixtures. Under the GC conditions which were employed, a peak is observed at elution times identical (to within 0.8%) to the S_2F_{10} peak in the $S_2F_{10}SF_6$ samples. Measurements made on $SO_2SOF_2SF_6$ mixtures indicate that SO_2 elutes from the column at times extremely close to but slightly longer than (by 10%) what we believe to be the S_2F_{10} peak. Although complete confirmation of the identification of S_2F_{10} in our sparked SF_6 samples awaits further measurements by mass spectrometry of the GC effluent, our conclusion based on these analyses indicates that S_2F_{10} is formed in amounts (on the order of hundreds of ppM) consistent with concentrations necessary for producing the toxic effects which we have previously observed. 13 refs., 3 figs., 1 tab.

36896 (CONF-880768—1) Direct determination of part-per-billion levels of volatile organics in water and soil samples using glow discharge mass spectrometry. Wise, M.B.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011389/JAW.

From 4. annual waste testing and quality assurance symposium; Washington, DC, USA (11 Jul 1988).

A low pressure glow discharge ion source has been constructed in our laboratory and interfaced with a quadrupole mass spectrometer for the direct monitoring of trace organic vapors in air. Important features of this ion source include a simple design, low cost, low maintenance, and the ability to sample air directly without the need for membranes, splitters, or capillary restrictors. Although the flow rate of air into the source is approximately 2 standard mL per second, the pressure within the ionization region is maintained at 200 mTorr which reduces interferences caused by the formation of water cluster ions. Furthermore, the high flow rate of air into the ion source provides a simple and convenient means of purging volatile organics from water or soil samples directly into the mass spectrometer without additional apparatus or extensive sample preparation. Early studies with this system indicate that low part-per-billion levels of volatile organics such as benzene or tri-chloroethylene can be quantitatively determined in water and soil samples either by monitoring headspace above a sample or by direct purging. Analysis time of 2-5 minutes provides a high throughput of 10 or more samples per hour.

36897 (CONF-880768—2) Recommendations for holding times of environmental samples. Maskarinec, M.P.; Johnson, L.H.; Holladay, S.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011831/JAW.

From 4. annual waste testing and quality assurance symposium; Washington, DC, USA (11 Jul 1988).

Experiments have been conducted for the purpose of establishing acceptable minimum holding times for soil and water samples. Analytes of interest have been volatile organics, pesticides, and explosives. The pesticides and explosives represent subclasses of semivolatile organics. Several soils and several water samples have been used in this investigation. The holding times for volatile organics in water samples are dependent on the objectives of the analysis. Aromatics and some haloethanes are stable in water for limited times, approximately 14 days is the recommended maximum. However, the degradation of these compounds can be eliminated or greatly reduced by preservation with acid. Several acids are recommended, including HCl, ascorbic acid, and sodium hydrogen sulfate. For analyses where only certain volatiles are to be considered, as in the case of RCRA monitoring, individual holding times can be recommended. For many of these volatiles, holding times can be recommended as long as one year, even without preservation.

36998 (DOE/ER/13542—2) Studies of the analyte carrier interface in flow injection analysis: Project report, June 1, 1987-February 1, 1988. Brown, S.D. (Delaware Univ., Newark (USA). Dept. of Chemistry). 1988. Contract FG02-86ER13542. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010794/JAW.

The goal of this project is the study of rapid multicomponent analysis of transient species in flowing media. Application of methods developed for multicomponent analysis is aimed at the investigation of dispersion-controlled chemical reactions at an analyte bolus-carrier solution interface, and the study of the effects of competition between analyte species on the distribution of products in chemical reactions. To meet these goals, study of new methods for the analysis of three-dimensional data resulting from measurement of transient species by sensor arrays or by rapid-scan (or multiplex) detection has commenced. Research has concentrated on three areas during the past year. These areas are (1) flow reaction analysis, (2) modeling of complex reaction kinetics, and (3) new methods for multicomponent analysis of inadequately modeled systems. Progress in each area is evaluated. 3 figs.

36999 (DOE/ER/13591—2) Dual mechanism bifunctional polymers: Design, synthesis and application of a new category of metal ion complexing agents: Progress report, August 1, 1987-July 31, 1988. Alexandratos, S.D. (Tennessee Univ., Knoxville (USA)). Apr 1988. Contract FG05-86ER13591. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008233/JAW.

Ionic recognition between a polymer and an ion can yield a highly specific separation agent for the recovery of target ions in dilute solutions. Reactive polymers named dual mechanism bifunctional polymers consist of polymers which interact with ions via two different mechanisms through two different groups. Research during the current period has focused on metal ion studies with the Class II phosphonic acid/phosphonate ester resins, the development of a new Class II resin involving pseudocrown ether moieties, and introduction of the Class III ion exchange/precipitation resins. 9 refs. (DLC)

37000 (GKSS—87/E/39) Total-reflection X-ray fluorescence analysis. Prange, A. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 12p. (In German). Special print from G-I-T (Glas- Instrum.-Tech.) Fachz. Lab. (1987) v. 31 p. 513-526.

Total-reflection X-ray-fluorescence (TXRF) is a new method for the determination of trace elements. It is a special variant of the energy-dispersive X-ray fluorescence analysis (XRF). Contrary to conventional energy-dispersive XRF instruments, in TXRF the exciting X-ray beam impinges upon an optically flat sample support made of quartz glass at angles of incidence below the critical angle of total reflection. The specimen is prepared as a thin film. The detection power of the TXRF method is by 2 to 3 orders of magnitude better than that of conventional XRF which allows multielement determination down to the ultra trace-concentration level. The possibility of internal standardization on the basis of an inherent universal calibration curve, the simple specimen preparation and the minute sample masses required make TXRF also useful for routine investigations. Based on the principles of X-ray-fluorescence the TXRF method and its characteristics are described. Examples of application of aqueous and solid samples from the environment are given demonstrating the capability of TXRF.

37001 (GKSS—87/E/43) Nuclear data for elemental analysis of geological samples with 14 MeV neutrons. Pepelnik, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 5p. Special print from Nucl. Geophys. (1987) Vol. 1(3) p. 249-252.

Neutron activation analysis (NAA) with 14 MeV neutrons is an important tool for determining the main components in geological material. To increase the accuracy of the analysis, many reactions induced by 14 MeV neutrons have been investigated. Activation cross-sections, which are necessary for elemental analysis of geological samples, have been measured. As an example the 14 MeV NAA of sediment samples is described.

37002 (GKSS—87/E/47) Determination of trace elements in the water cycle by total-reflection X-ray fluorescence spectrometry. Prange, A.; Knoth, J.; Stoessel, R.P.; Boeddeker, H.; Kramer, K. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 14p. Special print from Anal. Chim. Acta (1987) v. 195 p. 275-287.

The determination of trace elements in the various stages of the water cycle is very important. Economic procedures for multielement determinations of trace elements in various matrices are needed. The applications of total-reflection X-ray fluorescence spectrometry in this general area are reviewed briefly, with examples relating to rain, river and sea waters, sediments, particulate matter and manganese nodules and crusts, as well as mussel tissue. Up to 25 elements can be determined; these are S, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Pb, Se, Rb, Sr, Y, Zr, Mo, Ag, Cd, Sb and Ba. Preliminary treatments of the various matrices are described. Accuracy checks by analysis of reference standards and by application of independent techniques are reported.

37003 (GKSS—87/E/48) Element patterns in healthy and diseased Norway spruce (Picea abies) measured by inductively-coupled plasma/atomic emission spectrometry and total-reflection X-ray fluorescence spectrometry. Berneike, W.; Ehlers, W.; Knoth, J.; Rademacher, P. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 10p. Special print from Anal. Chim. Acta (1987) v. 195 p. 289-297.

Nutritive and toxic elements in growth rings of stem wood and in phloem, needles, and fine roots were determined by using inductively-coupled plasma/atomic emission spectrometry and total-reflection X-ray flourescence spectrometry. Along with the tree tissues, soil solutions were also analyzed. Trees were selected from different West German sites with wide variations in the degree of damage. Concentrations are presented for Ca, Mg, K, Fe, Mn, Al, Na, Sr, Ba, P, S, Si, Zn, Cu, Cd and Pb. The results are discussed in terms of correlations between concentrations of elements and status of disease.

37004 (GSCan-P—85-1B, pp 423-429) Radiocarbon dating with accelerator mass spectrometry. Results from Ellesmere Island, District of Franklin. Blake, W. Jr. (Geological Survey of Canada, Ottawa, Ontario). 1985. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780080/JAW.

In Current research.

Radiocarbon dating by means of accelerator mass spectrometry (AMS) has two great advantages over conventional dating: 1) much smaller samples can be handled and 2) counting time is significantly shorter. Three examples are given for Holocene-age material from east-central Ellesmere Island. The results demonstrate the potential use of this technique as a powerful research tool in studies of Quaternary chronology. Individual fragments of marine shells as small as 0.1 g have been dated successfully at the IsoTrace Laboratory, University of Toronto. In the case of an aquatic moss from a lake sediment core, an increment 0.5 cm thick could be used instead of a 5 cm-thick slice, thus allowing a much more precise estimate of the onset of organic sedimentation.

37005 (INIS-BR—1073) Application of X-ray technique to characterization of fluorite sample. Cancado, R.Z.L.; Luz Ferreira, O. da. (Minas Gerais Univ., Belo Horizonte (Brazil). Escola de Engenharia). 1986. 10p. (In Portuguese). (CONF-8611238—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702771/JAW.

From 41. annual congress of the Brazilian Association of Metals; Sao Paulo, Brazil (9 Nov 1986).

This investigation had the purpose of characterizing fluorite veins of "Mineracao Sartor", in Itaborai region/RJ, which is an excelent geographic position in relation to the consuming market. These studies have in view to give subsidy to future works to the best fluorite utilization. They realized tests with X-rays diffractometer and spectrometer, polarizing microscope and with a mounting of electric circuit to measure the type of semiconductivity. (C.M.C.T.R.).

37006 **(INIS-BR—1074) Reduction chlorination of slag containing niobium, tantalum and titanium.** Moura, F.J.; Brocchi, E.A. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Ciencia dos Materiais e Metalurgia). 1986. 17p. (In Portuguese). (CONF-8611238—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702772/JAW.

From 41. annual congress of the Brazilian Association of Metals; Sao Paulo, Brazil (9 Nov 1986).

Reduction chlorination experiments were carried out with slag containing niobium, tantalum in order to evaluate the effects of some variables on the behaviour of the material. Kinetic curves were obtained with the main variables being temperature and percentage of reducing agent. The reaults showed a greater effect of temperature as well as indicated the formation of the non-volatile chlorides ($CaCl_2$) as a factor reducing the reaction rate. Quantitative analyses of the material collected in the condenser indicated the viability of the method to recover the valuable metals.

37007 **(INIS-BR—1092) Rb/Sr and K/Ar determinations of Monguba and Pendanga rocks,Ceara.** Torquato, J.R.F.; Pedreira, L.H.; Kawashita, K.; Barbosa, H.S.P. (Ceara Univ., Fortaleza (Brazil). Dept. de Geologia). 1986. 14p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702789/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

In this paper we describe the petrography and geochronology of rocks from two quarries near the City of Fortaleza/Ceara. One, the Pedreira Monguba, is formed, basically, by rocks of the granitic to monzogranitic type. Its isochrone age is 672 +- 46 m.y. with an initial ratio of 0.7036 +- 0.0005. Datinfs of biotite by the K/Ar method gave values of 522+- 19m.y. for the consolidation of the region. For comparison with the other components of the same morphologic unit, the Massif of Maranguape, we designed a reference isochrone with all values available from the literature (for granite, gneisses and migmatites) and obtained a straight line parallel to the first, but with a higher initial ratio of 0.709, demonstrating the strong influence of the Brasiliano Cycle in this region. The other quarry, Pedreira Pendanga, is composed of gneisses and migmatized gneisses and forms an open chemical system. It was possible, however, to verify that its age is equal or greater than 2150+- 71 m.y. and that all of its rocks have suffered strong metamorphism during the Brasiliano Cycle as in shown by the K/Ar ages of biotites of 541+- 3 m.y. A discussion of sampling problems is given and the influence of a granitic intrusion on the chemical opening of the system is evidenced.

37008 **(INIS-BR—1101) Qualitative mineralogical characterization of the sinter by X-ray diffraction.** Greca, M.C.; Pietroluongo, L.R.V.; Baliza, S.V.; Costa Pereira, E.A. da. (Instituto Nacional de Tecnologia, Rio de Janeiro (Brazil)). 1987. 17p. (In Portuguese). (CONF-8710277—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702797/JAW.

From 42. annual congress of the Brazilian Association of Metals; Salvador, Brazil (18 Oct 1987).

This paper aims the qualitative mineralogical characterization of sinters and raw materials employed on its fabrication, via X-ray diffraction technique. Thus, sample with constant coke breeze content and variable contents of sand, limestone, dunite and dolomite were prepared to obtain current sinter compositions, with variable basicity. The tests were performed at the research of the following institutions: Companhia Siderurgica Nacional, Centro de Tecnologia Mineral and Instituto Nacional de Tecnologia.

37009 **(INIS-BR—1104) Alkaline intrusion of Pariquera - Acu: implication for South - Atlantic Evolution.** Ferreira, F.J.F.; Martins, F.A.G.; Monma, R.; Silva, R.B.; Rodrigues, E.P.; Coutinho, J.V.M.; Algarte, J.P.; Theodorovicz, A.; Tassinari, C.C.G. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1987. 1p. (CONF-8707165—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702870/JAW.

From 10. Brazilian congress of paleontology; Rio de Janeiro, Brazil (19 Jul 1987).

37010 **(INIS-BR—1105) New procedures to fossil characterization in the Taubate basin, SP.** Fernandes, A.C.S.; Polivanov, H.; Souza Carvalho, I. de. (Rio de Janeiro Univ. (Brazil). Museu Nacional). 1987. 1p. (In Portuguese). (CONF-8707165—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702800/JAW.

From 10. Brazilian congress of paleontology; Rio de Janeiro, Brazil (19 Jul 1987).

37011 (INIS-mf—11126, pp 108-109) **RNAA determination of As, Cd and Zn in biological materials.** Taskaev, E.; Penev, I.; Kinova, L. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). May 1985. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780068/JAW. (CONF-8505353—).

From 1. Balkan conference on activation analysis; Varna, Bulgaria (6 May 1985).

In connection with the IAEA project 3739RB the elements Hg, As, Cd and Zn in human spleen, kidney, heart, liver, SRM Bovine Liver 1577a and Bowen's Kale. The consecutive extraction have been chosen as the most rational approach determining these elements in a single specimen. Aiming at getting reliable results well established systems were used (ditizone to separate Hg, Cu and DEDTC to extract As, Cd and Zn). Special attention was paid to the accuracy of the determination. Monitoring, optimization and cooling time and control of chemical yield were carried out in each case. The samples were irradiated in the vertical channel of the IRT-2000 reactor in Sofia, in thermal neutron flux of about $5.10^{13}n.cm^{-2}.s^{-1}$ for 24 h. Iron monitor was used and cooling time varied from 20 h to 30 h.

37012 (INIS-mf—11126, pp 149-151) **Neutron activation analysis of some zircon samples from the Apuseni mountains (Romania).** Salagean, M.; Pantelica, A.; Znamirovschi, V.; Motiu, A. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). May 1985. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780068/JAW. (CONF-8505353—).

From 1. Balkan conference on activation analysis; Varna, Bulgaria (6 May 1985).

The concentrations of 23 elements in a zircon sample were determined using instrumental neutron activation analysis. The sample and the SL-1 and Soil-5 standards were irradiated for 50 hours in a thermal neutron flux of 1.1 x $10^{11}ncm^2.s$ in order to measure the long lived isotopes. For Zr measurements a ZrO_2 standard was used. The measurements were carried out by a Ge(Li) detector with 2 KeV resolution, after 8 to 30 days cooling time. To determine the short lived isotopes as Au, Dy, Mn, Ti and V, the sample was irradiated in a 2 x $10^{12}ncm^22.s$ flux for 1 min, using a W-1 standard. The results for major and trace element quantity ratios in zircon prove to be very interesting for geochemists and petrologists.

37013 **(INIS-mf—11227) 2nd conference on rare earths.** (Ceskoslovenska Vedeckotechnicka Spolecnost, Usti nad Labem. Dum Techniky). 15 May 1987. 92p. (In Czech and Slovak). (CONF-8704300—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702876/JAW.

From 2. conference on rare earths; Mikulov, Czechoslovakia (28 Apr 1987).

The conference heard a total of 16 papers of which 8 were incorporated in INIS, namely those dealing with the separation of rare earths from mineral raw materials (Kola apatite, bastnaesite ore), the best methods of preparing rare earth compounds for the

production of polishing powders, and design of an experimental mixer-settler. (E.S.).

37014 (INIS-mf—11227, pp 20-23) **Technology of production of high-level concentrate of rare earths from Kola apatite.** Bejrova, V. (Chemopetrol, Lovosice (Czechoslovakia)). 15 May 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702876/JAW. (CONF-8704300—).

From 2. conference on rare earths; Mikulov, Czechoslovakia (28 Apr 1987).

The procedure is described of separating rare earth elements from the Kola apatite which contains 0.7 to 1.0% oxides of rare earths. The separation takes place during the manufacture of combined fertilizer NPK-1. During the manufacture of the fertilizer the solution is neutralized with the precipitation of phosphates of rare earths. Increasing pH is accompanied by increased yield of the sum of rare earths. The yield is higher for lighter lanthanoids than for heavier lanthanoids. The phosphate concentrate is decomposed by nitric acid and rare earth elements are precipitated by oxalic acid. Following the annealing of the oxalate concentrate the obtained oxide concentrate will contain 92 to 95% oxides of rare earths. (E.S.).

37015 (INIS-mf—11227, pp 24-27) **Concept of separation technology for rare earth elements.** Slepicka, J. (Ustav Nerostnych Surovin, Kutna Hora (Czechoslovakia)). 15 May 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702876/JAW. (CONF-8704300—).

From 2. conference on rare earths; Mikulov, Czechoslovakia (28 Apr 1987).

The initial raw material for the designed separation of rare earth elements were flotation concetrates of bastnaesite ore from the Vietnamese Socialist Republic or phosphate concentrates produced during the manufacture of NPK fertilizer from the Kola apatite. A unified hydrometallurgical method shown in the figure was suggested for the reprocessing of the said concentrates. Liquid concentrate with a low content of Ce, without Th and with minimum content of fluorides enters the extraction separation: Di-2-ethylhexylphosphoric acid is used as the extraction agent. (E.S.). 1 fig.

37016 (INIS-mf—11227, pp 28-30) **Efficiency of selected separation techniques in rare earth element determination.** Weiss, B.; Sulcek, Z. (Ustredni Ustav Geologicky, Prague (Czechoslovakia)). 15 May 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702876/JAW. (CONF-8704300—).

From 2. conference on rare earths; Mikulov, Czechoslovakia (28 Apr 1987).

Briefly evaluated are various separation methods (instrumental, extraction, ion exchange chromatography, liquid chromatography) both for the group separation of trace elements and for the separation of individual elements. (E.S.).

37017 (INIS-mf—11227, pp 60-64) **Treatment of bastnaesite ore from Vietnamese Socialist Republic.** Formanek, J.; Jerabek, J.; Jancarek, J. (Ustav Nerostnych Surovin, Kutna Hora (Czechoslovakia); Ustav pro Vyzkum Rud, Mnisek pod Brdy (Czechoslovakia)). 15 May 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702876/JAW. (CONF-8704300—).

From 2. conference on rare earths; Mikulov, Czechoslovakia (28 Apr 1987).

From the Vietnamese deposit at Nam Nam Xe Czechoslovakia imported several hundred tons of ore. Several methods of ore dressing were used: gravitational, preconcentration in electromagnetic field, magnetic separation, high-intesity electromagnetic separation. Flotation evidently was the best dressing method tried. The results are presented of testing using different flotation agents. (E.S.).

37018 (INIS-mf—11227, pp 65-74) **Mixer-settler for extraction separation of rare earth elements.** Rozkos, B.; Haman, J. (Vyzkumny Ustav Chemickych Zarizeni, Prague (Czechoslovakia)). 15 May 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702876/JAW. (CONF-8704300—).

From 2. conference on rare earths; Mikulov, Czechoslovakia (28 Apr 1987).

A four-stage extractor is designed for research in the size of a 10 l mixer. The basic characteristics of the design are given. The test extractor will be made of ATLAC 580-05 resin laminate and will be subject to performance tests. (E.S.). 2 figs., 18 refs.

37019 (INIS-mf—11227, pp 82-85) **Selection of solvent for di-2-ethylhexylphosphoric acid for extraction separation of rare earth elements.** Zvolanek, S. (Ustav Nerostnych Surovin, Kutna Hora (Czechoslovakia)). 15 May 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702876/JAW. (CONF-8704300—).

From 2. conference on rare earths; Mikulov, Czechoslovakia (28 Apr 1987).

The separation of La, Gd and Y was made. The extraction constants of these elements and the average values of selective coefficients S(GdLa) and S(YGd) were determined for solvents: kerosene PS 1, aircraft kerosene PL-5, Nivol 2, NDF 2, isooctane, Escaid 100, Escaid 120 and toluene. Di-2-ethylhexylphosphoric acid concentration ranged between 0.97 and 0.99 moldm^3. It was found that the solvent NIVOL 2 of Czechoslovak make may be used for the extraction of rare earths but that values of extraction constants are ca 20% lower. (E.S.). 2 tabs., 6 refs.

37020 (INIS-mf—11227, pp 86-89) **Thorium elution from nitrate bastnaesite leachates with ion exchangers.** Marhol, M. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 15 May 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702876/JAW. (CONF-8704300—).

From 2. conference on rare earths; Mikulov, Czechoslovakia (28 Apr 1987).

Anion exchanger Wofatit SBW was used for selective sorption of Th from leaching solutions in the processing of bastnaesite ore. Chemical conditions of sorption were identified, and effects were studied on the rate of exchange in static and dynamic conditions. Experiments with actual samples were made. (E.S.). 1 tab.

37021 (JINR—18-87-406) **Multielement γ activation analysis of coal.** Sodnom, N.; Gehrbish, Sh.; Zhuchko, V.E.; Maslov, O.D.; Fiderkevich, A.; Khristov, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702129/JAW.

Submitted to the journal Khim. Tverd. Topl. .

A method of multielemental instrumental gamma activation analysis (IGAA) of coal using microtron bremsstrahlung is proposed. Activities of irradiated samples were measured by means of Ge(Li)- and HPGe-detectors. Quantitative determination of elements has been made using standard reference materials. This method allows one to determine concentrations of 36 elements in coal with detection limits down to 1 x 10^{-7} gg. The results of IGAA in coal from some mines of Mongolia and Poland are presented. 10 refs.; 5 figs.; 4 tabs.

37022 (LA—11297-MS) **Use of multivariate calibration for plutonium quantitation by the Pu(III) spectrophotometric method.** Wangen, L.E.; Phillips, M.V.; Walker, L.F. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010489/JAW.

Two new multivariate calibration methods for using all of the relevant spectral information are applied to the determination of plutonium. The analyte response signal originates from the absorbance spectrum of Pu(III)from 500 to 900 nm. Partial least squares (PLS) regression gives an average absolute error of 0.114 {+-} 0.108 mg when predicting plutonium content of standards containing 65 to 90 mg total plutonium. PLS uses all of the signal in the spectrum and is a more robust calibration procedure than a method based on absorbances at five wavelengths. Another calibration procedure involving least squares curve fitting (LSCF) fits either the entire spectrum or individual spectral intervals derived from standards to spectra of unknowns. In addition, an arbitrary linear base line can be included. The best LSCF option for the same calibration and test set as used for PLS was the full spectrum (522 to 900

nm) with a linear base-line option. The average absolute error when predicting with LSCF was 0.130 {+-} 0.092 mg plutonium. LSCF has an advantage over PLS in that the linear base line can account for certain types of interferences that have been observed for this plutonium assay procedure. An example is given. 6 refs., 3 figs., 5 tabs.

37023 **(LA—11298) Determining cerium in plutonium by anion exchange and x-ray fluorescence.** Martell, C.J.; Hansel, J.M. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010490/JAW.

This report describes a procedure for determining cerium in plutonium using an anion-exchange separation and x-ray fluorescence. We add lanthanum to the plutonium solution as an internal standard, oxidize the plutonium to Pu/sup {plus/4}, and pass the solution through an anion-exchange column with 8M HCl. The Pu/sup {plus/4} sorbs to the resin, and the cerium and lanthanum pass through the column completely. We evaporate the solution containing the cerium and the lanthanum to 0.5 mL for pipetting onto a resin paper disc. The Pu/sup {plus/4} is eluted off the column using 0.1M HCl. We then measure the K/sub α/ x-ray line for both cerium and lanthanum. The ratio of cerium to lanthanum for the sample is then compared with those from the standards. This method has a precision of 2.8% relative standard deviation for cerium over a concentration range of 0.1 to 5% cerium. 2 refs., 2 figs., 3 tabs.

37024 **(LA-UR—88-1249) Resonance ionization mass spectrometry of lead and bismuth mixtures.** Fearey, B.L.; Miller, C.M.; Anderson, J.E.; Nogar, N.S.; Rowe, M.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-880435—14). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009131/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

Resonance ionization of lead and bismuth has been demonstrated using an excimer laser pumped dye laser in three-photon, one-color ionization schemes, using a quadrupole mass spectrometer for detection.

37025 **(LA-UR—88-1281) Laser desorption/ablation studies by resonance ionization mass spectrometry.** Nogar, N.S.; Estler, R.C.; Rowe, M.W.; Fearey, B.L.; Miller, C.M. (Los Alamos National Lab., NM (USA); Fort Lewis Coll., Durango, CO (USA). Dept. of Chemistry; Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1988. Contract W-7405-ENG-36. 5p. (CONF-880435—12). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009124/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

Theory and results are presented for RIMS diagnostics of a variety of laser-materials interactions. 5 refs. 3 figs.

37026 **(NEI-NO—41) Determination of trace elements in seawater using Mg-scavenger as preconcentration agent, and neutron activation analysis.** Andersen, B. (Oslo Univ. (Norway)). 1986. 147p. (In Norwegian). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752493/JAW.

In order to determine trace elements in seawater, a preconsentration method based on coprecipitation on Mg(OH) 2 is presented. Different parameters influencing the carrying effects have been investigated using model solutions and radioactive tracers. The deposit and solution are separated by filtration. Filter with deposit is stored in quarts ampules for later determination of trace elements by means of neutron activation analysis. 63 refs.

37027 **(ORNL—6474) Analytical Chemistry Division annual progress report: For period ending December 31, 1987.** (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 140p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88010762/JAW.

This report is divided into analytical spectroscopy; radioactive materials analysis; inorganic chemistry; organic chemistry; ORNL environmental programs; quality assurance, safety, and training; supplementary activities; and presentation of research results.

37028 **(PCCF-T—87-09) Study of arsenic diffusion in dental therapy by nuclear methods.** Khalis, M. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire). Jul 1987. 101p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753976/JAW.

Activation by fast neutrons (14 MeV) allows the evaluation of radioactive arsenic distribution in the different parts of teeth of which the nerve was killed. As an average 60 % of the arsenic is found in the upper part 4.3 % in the middle part and 2.2 % in the apical part. About 34 % of arsenious anhydride is diffused into the organism. This quantitative analysis is a contribution to the therapeutic choice in function of element diffusion.

37029 **(PINSTECH/NMD—118) Computerization of the iteration procedure for calculating the number of stages in counter-current solvent extraction system.** Shahid, K.A.; Sadiq, A. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Materials Div.). Aug 1986. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702480/JAW.

Solvent extraction of metals is a powerful technique for the purification and separation of various metals. This report gives some of the applications of solvent extraction for separation of metals on an industrial scale, and gives the solvents and other chemicals added for promoting extraction or separation. The power of the technique arises from the fact that the process can lend itself to multisage operation without increased consumption of heat or chemicals. In a design for a solvent extraction system, the size of the plant is determined by the number of stages required for desired extraction or separation. The present paper concerns with the development of a computer programme for these calculations. (orig./A.B).

37030 **(PNL—5109-103) Characterization of spent fuel approved testing material: ATM-103.** Guenther, R.J.; Blahnik, D.E.; Campbell, T.K.; Jenquin, U.P.; Mendel, J.E.; Thomas, L.E.; Thornhill, C.K. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 267p. NTIS, PC A12/MF A01;1; GPO Dep. Order Number DE88011767/JAW.

The characterization data obtained to date are described for Approved Testing Material (ATM)-103, which is spent fuel from Assembly D101 of pressurized-water reactor Calvert Cliffs, No. 1. This report is one in a series being written by the Materials Characterization Center (MCC) at Pacific Northwest Laboratory (PNL) on spent fuel ATMs. The ATMs are receiving extensive examinations to provide a source of well-characterized spent fuel for testing in the US nuclear waste repository program. ATM-103 consists of 176 full-length irradiated fuel rods with rod-average burnups of about 2600 GJ/kgM (30 MWd/kgM) and less than 1% fission gas release. Characterization data include 1) as-fabricated fuel design, irradiation history, and subsequent storage and handling; 2) isotopic gamma scans; 3) fission gas analyses; 4) ceramography of the fuel and metallography of the cladding; 5) special fuels studies involving analytical transmission electron microscopy (AEM); 6) calculated nuclide inventories and radioactivities in the fuel and cladding; and 7) radiochemical analyses of the fuel and cladding. Additional analyses of the fuel are being conducted and will be included in planned revisions of this report. 10 refs., 103 figs., 63 tabs.

37031 **(PNL-SA—15318) Plutonium, uranium, nitrate measurements in PUREX process stream by remote fiber optic diode array spectrophotometry.** Baldwin, D.L.; Stromatt, R.W. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 17p. (CONF-8710146—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009486/JAW.

From Plutonium/uranium recovery operations conference; Richland, WA, USA (12 Oct 1987).

There is increasing interest in the development of real-time or near real-time spectrophotometric measurement of Pu(III), Pu(IV), Pu(VI), uranium, and nitrate in nitric acid in a process stream. A broad foundation for this measurement technique has been built at Savannah River Laboratory for the Savannah River Plant. A project is underway at Pacific Northwest Laboratory to develop the technology for PUREX plant process chemistry. The first application is the Plutonium Stripper Feed, where Pu(IV) concentrations of 10 to 50 g/L are expected, with Pu(III) and Pu(VI) being up to one tenth of that level. Nitrate concentrations of 1 to 3 {und}M are expected. This is the major difference between this application at PUREX and the work progressing at SRL, in which Pu concentrations are considerably less and nitrate levels of are considerably higher. This paper discusses the progress of our work, explains the hardware involved, discusses the use of the chemometric regression method, Partial Least Squares, and discusses the results obtained to date.

37032 **(PNL-SA—15378) Trace isotopic analysis by double-resonance ionization with cw [continuous-wave] lasers and graphite furnace atomization.** Bushaw, B.A.; Gerke, G.K. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 5p. (CONF-880435—19). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009490/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

Two high-resolution, single-frequency dye lasers and a cw CO_2 laser have been used to saturate photoionization of atoms generated by a graphite furnace. Isotopic selectivities of greater than 10^8 have been observed in the double-resonance excitation to Rydberg states, and coupling laser selectivity with a quadropole mass spectrometer yields isotopic abundance sensitivities in excess of 10^{10}. Instrumental detection limits of {approximately}10/sup {minus/17} grams have been demonstrated. 2 refs., 4 figs.

37033 **(PNL-SA—15415) Low-level radionuclide analysis using resonantly enhanced collisional ionization.** Gerke, G.K.; Bushaw, B.A.; Whitaker, T.J. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 5p. (CONF-880435—16). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009473/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

Laser excitation produces highly excited atoms which are efficiently ionized by collisions with an inert buffer gas. This effect, resonantly enhanced collisional ionization (RECI), is being developed as a means of measuring radionuclides of interest to internal dosimetry; specifically, uranium and transuranic species. Initial proof-of-principle experiments have given femtogram detection limits for calcium. Recently, RECI signals have been observed from uranium and detection limits in the same range are anticipated. For the transuranics, where isotope shifts are large, modest laser bandwidths of {approximately}0.1 cm/sup {minus/1} can provide isotopic selectivity in the excitation process. 4 refs., 2 figs.

37034 **(UCRL—97403) Infrared analysis of liquid and solid D-T.** Souers, P. C.; Fearon, E. M.; Stump, R. K.; Tsugawa, R. T. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 14p. (CONF-880505—20). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011336/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The composition of a liquid or solid deuterium-tritium mixture may be measured by collision-induced infrared spectroscopy. For T_2, DT and D_2, respectively, we measure the areas under the absorption peaks in the regions 76.75-80.19, 85.29-88.74 and 92.79-96.23 THz (2560-2675, 2845-2960 and 3095-3210 cm/sup {minus/1}). These areas are multiplied, respectively, by these isotopic sensitivities derived from quantum calculations: 1.000, 0.891 and 0.811. The resulting numbers are proportional to the molar composition. Nearly equimolar D-T samples show good agreement between mass and infrared spectroscopy. The large DT peak in enriched molecular DT overemphasizes D_2 in the infrared analysis, but these results may be corrected with the room temperature, mass spectroscopic D-to-T ratio.

37035 **(UCRL—97403-Rev.1) Infrared analysis of liquid and solid D-T.** Souers, P.C.; Fearon, E.M.; Stump, R.K.; Tsugawa, R.T. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 5p. (CONF-880505—20-Rev.1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88011722/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Collision-induced infrared spectroscopy may be used to measure the composition of a liquid or solid deuterium-tritium (D-T) mixture. For T_2, DT and D_2, respectively, we measure the areas under the absorption peaks in the regions 76.75 to 80.19, 85.29 to 88.74, and 92.79 to 96.23 THz (2560-2675, 2845-2960, and 3095-3210 cm/sup {minus/1}). These areas are multiplied, respectively, by these isotopic sensitivities derived from quantum calculations: 1.000, 0.891, and 0.811. The resulting numbers are proportional to the molar composition. Nearly equimolar D-T samples show good agreement between mass and infrared spectroscopy. The large DT peak in enriched molecular DT overemphasizes D_2 in the infrared analysis, but these results may be corrected with the room-temperature, mass-spectroscopic D-to-T ratio. 7 refs., 2 figs., 2 tabs.

37036 **Flame temperature measurements using the anomalous fluorescence of pyrene.** Peterson, D.L.; Lytle, F.E.; Laurendeau, N.M. (Marion Laboratories, Inc., Kansas City, Missouri 64134). *Applied Optics;* 27: No. 13, 2768-2775(1 Jul 1988).

We have evaluated the anomalous of pyrene as a method for determining flame temperature. Vapor-phase pyrene was injected into four premixed hydrogen/oxygen flames at equivalence ratios of 1.0 and 1.5 and pressures of 22 and 72 Torr. For each flame, the relative laser-induced $(S_2 \rightarrow S_0)/(S_1 \rightarrow S_0)$ emission was monitored as a function of height above the burner and compared to the temperature profile as measured by miniature thermocouples. The thermal behavior of pyrene is discussed in terms of a modified intermediate strong-coupling model. A theoretical calculation of the temperature dependence of the S_2/S_1 emission ratio agrees well with the experimental flame-temperature data. Based on this agreement, conditions are delineated for the most suitable use of pyrene as a molecular temperature probe.

37037 **Serendipity, technology, and challenges in chemical instrumentation.** Yeung, E.S. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* 60: No. 7, 441A-449A(1 Apr 1988). Contract W-7405-ENG-82.

Serendipity, technology, and challenges in chemical instrumentation each play a vital role in the development of science. Edward S. Yeung of Iowa State University speaks from personal experience about the factors that guide research.

37038 **Gradient elution for micellar electrokinetic capillary chromatography.** Balchunas, A.T.; Sepaniak, M.J. (Univ. of Tennessee, Knoxville (USA)). *Analytical Chemistry;* 60: No. 7, 617-621(1 Apr 1988). Contract FG05-86ER13613.

A method for performing gradient elution in micellar electrokinetic capillary chromatography is developed. The influence of temperature and mobile phase organic solvent concentration on capacity factors is presented and attributed to changes in phase ratio and solute distribution coefficient. Solvent programming is more effective than temperature programming at adjusting retention due to its greater influence on distribution coefficient. As anticipated, phase ratio changes could not be exploited due to concomitant losses in column efficiency. A stepwise solvent gradient involving increasing concentrations of 2-propanol and Triton-X-100 is used for the separation of a test mixture of derivatized amines.

37039 **Separation and identification of polycyclic aromatic hydrocarbon isomers of molecular weight 302 in complex mixtures.** Wise, S.A.; Benner, B.A.; Liu, H.; Byrd, G.D.; Colmsjoe, A. (National Bureau of Standards, Gaithersburg, MD (USA)). *Analytical Chemistry;* 60: No. 7, 630-637(1 Apr 1988). Contract AI05-86ER60428.

The determination of dibenzopyrenes and dibenzofluoranthenes (isomers of molecular weight 302) in complex mixtures has received relatively little attention for several reasons including low concentrations in environmental samples, the number of possible isomers, and the lack of reference compounds for comparison. In this paper they describe the separation and identification of isomers of molecular weight 302 in a coal tar extract. The compounds were isolated from the extract by normal-phase liquid chromatography (LC). Thirteen isomers were identified by using a combination of reversed-phase LC, gas chromatography, gas chromatography/mass spectrometry, and low-temperature (Shpol'skii) fluorescence spectroscopy.

37040 **Indirect fluorometric detection of anions in thin-layer chromatography.** Ma, Y.; Yeung, E.S. (Ames Lab., IA (USA)). *Analytical Chemistry;* 60: No. 7, 722-724(1 Apr 1988). Contract W-7405-ENG-82.

Thin-layer chromatography (TLC) is a broadly applicable separation technique. There is a technique for TLC quantitation known as fluorescence quenching. In fact, commercial TLC plates are available with a fluorophor already incorporated for this purpose. It is really a misnomer because rarely does the analyte actually change the fluorescence quantum yield of the fluorophor. In reality that is only a modified absorption technique. The analyte absorbs the excitation light (or the emitted light), and depletes the amount of fluorescence. The advantage is the elimination of UV optics in the observation of emission, so that direct visualization is possible for UV chromophors. Sensitivity is at best comparable to UV transmission or UV reflectance spectrometry. In this article, they describe the detection of nonfluorescing and nonabsorbing anions. Displacement of a fluorescing (background) eluting ion by the analyte ion due to electroneutrality gives rise to the response.

37041 **Electronic energy levels of small polyatomic transient molecules.** Jacox, M.E. (Theoretical Astrophysics 130-33, California Institute of Technology, Pasadena, California 91125). *Journal of Physical and Chemical Reference Data;* 17: No. 2, 269-511(Apr 1988).

The experimentally determined eletronic energy levels of approximately 500 neutral and ionic transient molecules possessing from 3 to 6 atoms are tabulated together with the associated vibrational structure, the radiative lifetime, the principal rotational constants, and references to the pertinent literature. Vibrational and molecular beams, and in rare-gas and nitrogen matrices are included. The types of measurement surveyed include conventional and laser- based absorption and emission techniques, laser absorption with mass analysis, and ultraviolet photoelectron spectroscopy.

37042 **Laser desorption and ionization of solid polycyclic aromatic hydrocarbons in air with analysis by ion mobility spectrometry.** Eiceman, G.A.; Anderson, G.K.; Danen, W.C.; Ferris, M.J.; Tiee, J.J. (New Mexico State Univ., Las Cruces (USA)). *Analytical Letters;* 21: No. 4, 539-552(Apr 1988).

Solid polycyclic aromatic hydrocarbons with 4-7 rings on metal, glass, ceramic, and plastic substrates were desorbed and ionized in air with a quadrupled Nd-YAG laser. Gaseous product ions were analyzed at ambient conditions in air directly using ion mobility spectrometry. Ablation rates for perylene on borosilicate glass were estimated as 0.01 ng/mm^2 per pulse and standard deviation for peak heights with roughly 1 μg/mm^2 was 34%. Substrate interference was avoided by using an unfocused laser beam at 0.5-1 mJ/pulse although gaseous ions also could be generated from substrates with a focused beam at 1 mJ/pulse.

37043 **Pressure programmed microbore column supercritical fluid chromatography-mass spectrometry for the determination of organophosphorus insecticides.** Kalinoski, H.T.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). *Analytical Chemistry;* 60: No. 6, 529-535(15 Mar 1988). Contract AC06-76RL01830.

The use of the high flow rate (HFR) interface for supercritical fluid chromatography-mass spectrometry (SFC-MS) is shown to allow operation under conditions which provide efficient pressure programmed separations with appropriate microbore (packed) HPLC columns. The combined advantages of selectivity offered by the microparticle-packed stationary phase and variable solvating power of the supercritical fluid are fully utilized in this approach. The greater sample loadings and lower detection limits possible using packed columns (based on concentration of sample in the injection solvent) compared with commercially available capillary columns are demonstrated for the determination of a series of organophosphorus insecticides. Low concentrations of polar fluid modifiers, generally required for high-quality separations in packed-column SFC, also function as mild chemical ionization reagents. Broad classes of thermally labile, higher molecular weight, moderately polar pesticides are amenable to identification by SFC-MS, which provides a sensitive, selective, and broadly applicable technique for the identification of pesticide compounds with detection limits in the part-per-billion range.

37044 **Selective enhancement of room temperature phosphorescence using cyclodextrin-treated cellulose substrate.** Alak, A.M.; Vo-Dinh, T. (Oak Ridge National Lab., TN (USA)). *Analytical Chemistry;* 60: No. 6, 596-600(15 Mar 1988). Contract AC05-84OR21400;AC05-76OR00033.

The selective enhancement of room temperature phosphorescence (RTP) for a wide variety of polynuclear aromatic hydrocarbons (PNAs) on cyclodextrin-treated filter paper was investigated. Filter paper substrates were treated by simple impregnation in saturated solutions of α, β, and γ-cyclodextrins. The results show different RTP enhancement factors for PNAs depending on the type of cyclodextrin (CD) used and on the binding strength between the cyclodextrin and the PNAs. A two-component mixture of PNAs was analyzed by RTP and synchronous RTP in order to illustrate the improved sensitivity of the RTP technique and demonstrate the selective enhancement by cyclodextrin (SCED) methodology in multicomponent analysis.

37045 **Optical pH sensor based on the chemical modification of a porous polymer film.** Jones, T.P.; Porter, M.D. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* 60: No. 5, 404-406(1 Mar 1988). Contract W-7405-ENG-82.

A new approach to the design and construction of an optical pH sensor has been developed by immobilizing a direct azo dye at a porous cellulosic polymer film. This sensor was fabricated by binding Congo Red to a cellulose acetate film that had previously been subjected to an exhaustive base hydrolysis. Advantageous features of the design include (1) a rapid equilibration time (< 1.3 s), (2) a large dynamic range (> 4 pH units), and (3) ease of fabrication. The rapid response results from the porous structure of the polymeric support, which minimizes barriers to mass transport. The large dynamic range results from both the polyprotic acid-base reactivity of Congo Red and the large optical absorptivities of its various ionic forms. Furthermore, these results indicate that a variety of optical sensors which exhibit a rapid and sensitive response for the analysis of pH can be easily fabricated by immobilizing carefully selected direct dyes at porous polymeric substrates such as hydrolyzed cellulose acetate.

37046 **Self-cleaning, continuous cooling belt for low-temperature molecular luminescence spectrometry.** Jones, B.T.; Winefordner, J.D. (Univ. of Florida, Gainesville (USA)). *Analytical Chemistry;* 60: No. 5, 412-415(1 Mar 1988).

A device for rapidly cooling small amounts of sample to 15 K is described. The device employs a thin brass belt connected at the ends to form a loop. At one end, the loop is in contact with the cold stage of a closed-cycle helium refrigerator. Samples (50 μL) are injected through a septum in the vacuum chamber onto the cold portion of the belt. After the analysis, the belt carries the

sample away from the cold stage where it warms and evaporates. The cooling device is therefore self-cleaning. In this study, 11 polynuclear aromatic hydrocarbons (PAHs) dissolved in Shpol'skii solvents are determined by xenon arc excited low-temperature molecular luminescence spectrometry.

37047 **Capillary zone electrophoresis - mass spectrometry using an electrospray ionization interface.** Smith, R.D.; Olivares, J.A.; Nguyen, N.T.; Udseth, H.R. (Pacific Northwest Lab., Richland, WA (USA)). *Analytical Chemistry;* 60: No. 5, 436-441(1 Mar 1988). Contract AC06-76RL01830.

Instrumentation developed for capillary zone electrophoresis-mass spectrometry (CZE-MS) is described. The interface is based upon direct electrospray ionization from the end of the CZE capillary. The electrospray ionization source functions at atmospheric pressure and provides excellent sensitivity for wide ranges of compounds, with detection limits generally in the femtomole range (although significant improvements appear feasible). The instrumentation allows the high separation efficiencies feasible with CZE to be exploited and offers potential advantages compared with LC-MS methods, particularly when only small samples are available or high-resolution separations are necessary. The performance of the electrospray interface and the techniques and operating conditions for CZE-MS separations are described. CZEMS separations and mass spectra are shown for mixtures that include polypeptides and quaternary ammonium salts. Separation efficiencies and detection limits vary widely from compound to compound and are shown to be sensitive to buffer selection. Separation efficiencies exceeding half a million theoretical plates are demonstrated for some compounds. Wider application and improved performance are anticipated with minimization of CZE band spread (due to adsorption and possibly other processes) and optimization of CZE buffers (for both the separation and their compatibility with electrospray ionization).

37048 **Organics in water: solid phase extraction on a small scale.** Junk, G.A.; Richard, J.J. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* 60: No. 5, 451-454(1 Mar 1988). Contract W-7405-ENG-82.

Octadecyl (C-18) bonded to porous silica has been evaluated for the solid-phase extraction (SPE) of organic compounds from water. Excellent performance was deduced from average recovery of > 85% for pesticides and polycyclic organic materials present in contrived water samples at 1-10 ng/mL. Extraction results showed effective performance of the SPE when 1-100 mL of water was passed through small columns containing 40-100 mg of 40-μm C-18 bonded porous silica at flow rates as high as 250 bed volumes/min. The adsorbed compounds were removed by collecting 60-100 μL of either ethyl acetate or benzene eluate. The unique feature of this research is the combination of small water volumes, fast flow rates, small columns, and small eluate volumes that obviate solvent removals prior to GC analysis, while still retaining all the other advantageous features of SPE. Excellent performance was also confirmed in tests of environmental waters where the results based on SPE agreed with those based on accepted classical extractions.

37049 **Resonant Raman scattering as a source of increased background in synchrotron excited x-ray fluorescence.** Jaklevic, J.M.; Giauque, R.D.; Thompson, A.C. (Univ. of California, Berkeley (USA)). *Analytical Chemistry;* 60: No. 5, 482-484(1 Mar 1988). Contract AC03-76SF00098.

Experiments that study the optimization of tunable monochromatic synchrotron radiation for X-ray fluoreacence analysis have demonstrated the importance of resonant Raman X-ray scattering in establishing the minimum detectable limit for certain types of trace analysis. These analyses involve the measurement of elements with atomic numbers less than the predominant matrix elements in which the fluorescence of the matrix components is eliminated by selecting excitation energies immediately below major absorption edges. The cross section for Raman scattering from the matrix atoms can be resonantly enhanced resulting in a significant increase in continuum background below the fluorescence peaks of elements of interest. Significant increases in minimum detectable limits have been observed for gallium arsenide samples.

37050 **Performance of an improved monodisperse aerosol generation interface for liquid chromatography/mass spectrometry.** Winkler, P.C.; Perkins, D.D.; Williams, W.K.; Browner, R.F. (Georgia Institute of Technology, Atlanta (USA)). *Analytical Chemistry;* 60: No. 5, 489-493(1 Mar 1988).

An improved monodisperse aerosol generation interface for liquid chromatography/mass spectrometry interfacing (MAG-IC-LC/MS) is described. The interface has an aerodynamically superior momentum separator, which results in decreased analyte loss in passing through the interface. The interface is shown to perform well with a quadrupole mass spectrometer, in addition to earlier studies with a magnetic sector instrument. A new method of forming aerosol has been developed, which reduces the dead volume significantly over earlier designs. The performance of the interface has been evaluated by studying its capabilities for (1) generating electron impact spectra of searchable quality for selected compounds of interest, (2) operating with typical liquid chromatographic separation conditions, including reverse phase and gradient elution, and (3) providing low detection limits for both full scan and selective ion monitoring detection of a range of compounds. Studies include identification of the components of a mixture of cis and trans isomers of the thermally labile compound retinol (vitamin A) acetate. Full scan (m/z 80-350) electron impact spectra were readily obtained with 50-ng injection on-column. Detection limits for this compound were 10 ng full scan and 1 ng with selected ion monitoring. Identification of a free (nonderivatized) fatty acid mixture was also readily obtained, using a reversed-phase separation in gradient mode.

37051 **Wick evaporation: a technique for the isolation of soluble analytes from volatile solvents.** Chriswell, C.D.; Markuszewski, R. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* 60: No. 5, 508-509(1 Mar 1988). Contract W-7405-ENG-82.

Wick evaporation is a simple and effective specialized technique useful for recovering small amounts of soluble, nonvolatile analytes from volatile solvents. Despite its obvious utility, this wick evaporation technique, which has been used in their laboratory for over 10 years, has not been reported to their knowledge in the literature and appears to be unknown to most analysts. In past work at the Ames Laboratory, wick evaporation has been applied to the isolation of polyaromatic hydrocarbons from diethyl ether extracts of drinking water. The technique is likely to be applicable to similar applications in which small amounts of low-volatile analytes are isolated into volatile solvents. In the present work, the isolation of elemental sulfur from small samples of coal-derived humic-like materials is described as another example of the utility of this technique. In this application, wick evaporation serves both as a means for separating the soluble elemental sulfur from insoluble humic-like materials and as a means for concentrating the separated elemental sulfur in a small, accessible area on the wick tip.

37052 **Effects of dilution of poly(ethylvinylbenzene-divinylbenzene) adsorbent on the adsorption of aliphatic, alicyclic, and aromatic hydrocarbon adsorbates from effective zero to finite surface coverage.** Djordjevic, N.M.; Laub, R.J. (San Diego State Univ., CA (USA)). *Analytical Chemistry;* 60: No. 2, 124-130(15 Jan 1988).

The chromatographic measurement and systematic interpretation of the solidgas partition coefficients K/sub s/ and related thermodynamic properties of a number of hydrocarbon adsorbates (n-pentane through n-octane, cyclohexane, methylcyclohexane, benzene, dichloromethane, chloroform, carbon tetrachloride, tetrahydrofuran, thiophene, and acetone) at effective zero surface coverage with a 1:10 admixture of the title adsorbent-inert diluent from 393 to 443 K are reported. Despite a difference of an order of magnitude in the surface areas of bulk and admixed packings, the adsorbate relative retentions were in good agreement with those found in previous work with neat Porapak Q. The heats of adsorption also coincided to within an experimental error of ca. +- 5%. The GSC technique of elution by characteristic point was then used to derive the finite-concentration adsorption isotherms and isosteric heats of adsorption on n-hexane, cyclohexane, benzene, carbon tetrachloride, and acetone adsorbates with diluted Porapak Q over the tem-

perature range 393-433 K. All exhibited BET Type IV isotherms, as well as changes in the respective isotherm temperature coefficients. The latter is said to be a consequence of the microporous substructure of this adsorbent.

37053 **Gas adsorption on structurally heterogeneous microporous solids.** Jaroniec, M.; Madey, R. (Kent State Univ., OH (USA)). *Separation Science and Technology;* 22: No. 12, 2367-2380(Dec 1987).

Isotherm equations for gas adsorption on microporous adsorbents are derived for four distribution functions that characterize the structural heterogeneity of the solids. Since these functions represent the size distributions of micropores, they are physically meaningful for describing gas adsorption on heterogeneous microporous solids. Presentation of relationships between the distribution functions describing either structural or energetic heterogeneity of a solid increases the utility of previous distribution functions for characterization of microporous adsorbents.

37054 **Optimization of solvent composition for high performance thin-layer chromatography.** Bayne, C.K.; Ma, C.Y. (Computing and Telecommunications Div., Oak Ridge National Lab., Oak Ridge, TN (US)). *Journal of Liquid Chromatography;* 10: No. 16, 3529-3546(1987). Contract AC05-84OR21400.

The methodology of mixture experiments has been applied to optimize the multicomponent solvent composition for high performance thin-layer chromatography (HPTLC). In this study, a mixture of five solvents for the mobile phase was maximized for the separation of twelve structurally related B(a)P metabolites on normal phase HPTLC plates. Volume fractions (rather than absolute quantities) of the mobile phase solvents were constrained by upper bounds by considering solvent strength. These restrictions defined an experimental region that is an irregular polyhedron formed from a truncated 4-dimensional simplex. The optimization of the expected separation response over the experimental region was based on a second-order Scheffe polynomial estimated from twenty-five experimental runs. Six functions for measuring separation based on R/sub f/ values were evaluated. A new response function is proposed that overcomes the difficulties of previously published criteria.

37055 **Analysis of radioactive waste and glass for a defense waste solidification plant.** Coleman, C.J.; Baumann, E.W.; Bibler, N.E.; Dewberry, R.A.; Sturcken, E.F. (E. I. du Pont de Nemours and Co., Aiken, SC (USA)). pp 9-10 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC09-76SR00001.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Analytical methods have been developed and evaluated for supporting a high-level radioactive waste solidification plant. Radioactive defense waste from the Savannah River Plant will be combined with glass-making chemicals and melted at 1150°C to form borosilicate glass. This glass will then be placed in safe permanent disposal. Remote methods for dissolving and analyzing melter feed and glass containing actual radioactive waste were demonstrated in shielded cells. Microwave technology was used to dissolve samples and measure moisture content. A colorimetric method for measuring the Fe(II)/Fe(III) ratio in the glass was developed and demonstrated using a fiber optic-coupled spectrophotometer. Other methods for characterizing feed and glass samples include elemental analysis by ion chromatography, inductively coupled plasma-atomic emission spectroscopy, and atomic absorption spectrometry. Major radionuclides, ^{137}Cs, ^{90}Sr, and ^{238}Pu could be measured directly by counting techniques. Minor radionuclides such as ^{99}Tc required separation procedures prior to counting.

37056 **Automated fuel scanning system.** Robinson, L.; Dyer, F.F.; Hobbs, R. (Oak Ridge National Lab., TN (USA)). pp 10 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC05-84OR21400.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

In association with the high-enriched uranium (HEU) fuel to low-enriched uranium (LEU) fuel conversion program, an experimental technique has been developed at the Oak Ridge Research Reactor (ORR) which allows the study of the burn-up characteristics of an LEU fuel core. This 30-megawatt pressurized-water reactor will now serve as a source of freshly irradiated LEU fuel for study, and as a working example of the feasibility of the conversion. The fuel cycle at the ORR typically extends from 14 to 21 days. At the end of each cycle, individual fuel elements are analyzed non-destructively using gamma-ray spectroscopy. Due to the high radiation levels associated with each element, conventional laboratory techniques were inapplicable which necessitated the development of an automated and remotely controlled fuel scanning system. In this talk, the fuel scanning system will be described and information obtained using it regarding the burnup and power distribution in the ORR's core will be presented.

37057 **Optimization considerations in ICP-MS.** Parsons, M.L.; Bentley, G.E.; Hoard, D.J.; Coffelt, K.P. (Los Alamos National Lab., NM (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

Most studies involving the optimization of an ICP-MS have considered that the MS is independent from the ICP and have not included the possibility for interdependent behavior. In fact the flow rates at the sampling port as well as the ion flux should be important parameters in the ion focusing lens system at the input of the mass spectrometer. They have undertaken optimization experiments to evaluate the ICP-MS combination as a unit, utilizing both ICP parameters and MS parameters. The approach is to utilize the modified SIMPLEX procedure incorporating appropriate MS lens variables in addition to the conventional ICP variables. The response function studied was the ion current for selected isotopes of selected atomic ion species. Two atomic species were selected for these preliminary studies, one of high and one of low ionization energy. The discussion will focus on the interrelationships between the ICP and the MS parameters and the important parameters to use in optimization studies.

37058 **Development and applications of room temperature phosphorescence in chemical and biological analysis.** Vo-Dinh, T. (Oak Ridge National Lab., TN (USA)). pp 55 of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

The room temperature phosphorescence (RTP) technique is a simple and practical approach in phosphorescence analysis. Unlike conventional low-temperature phosphorimetry, the RTP technique does not require cryogenic equipment and low temperature refrigerant. For a number of years the RTP technique has been developed into a cost-effective and practical tool for screening chemical pollutants such as the poly-nuclear aromatic (PNA) compounds in complex mixtures. Recent results of this screening methodology applied to environmental analysis will be presented. Analyte-substrate interaction studies will also be discussed. They have also further developed the RTP technique for detecting biological systems. An example of biological applications is the detection of carcinogen-DNA adducts products by laser-induced RTP. The results indicate that the RTP technique provides a promising screening tool for monitoring human exposure to carcinogenic PNA compounds.

37059 **Serendipity, technology, and challenges towards better chemical instrumentation.** Yeung, E.S. (Iowa State Univ., Ames (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

Very often, the development of new or improved chemical instrumentation is influenced by factors other than the natural maturation of science. A fortuitous conversation about lipids led to their work on polarimetric detection in liquid chromatography. Advances became possible because of the availability of high quality laser optics, microbore columns, and high-frequency modulation techniques. The challenge of simplifying procedures for crude oil characterization led to the concept of quantitation without standards. In turn, that generated interest in further developments in indirect detection schemes. Instruments that do not normally respond to an analyte can still be used to detect it. The application of laser spectroscopy to chemical analysis has also benefited from new technologies such as frequency-stabilized lasers, high-power high-repetition lasers and acousto-optical beam deflectors. Recent examples from their laboratory will be presented.

37060 **Applications of line narrowing laser spectroscopies to biological systems.** Small, G.J.; Hayes, J.M.; Jankowiak, R.; Gillie, J.K.; Cooper, R.S.; Zamzow, D. (Iowa State Univ., Ames (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

Site excitation energy (isochromat) selective laser spectroscopies such as fluorescence line narrowing (FLN), photochemical and nonphotochemical hole burning (PHB, NPHB) have found wide ranging application from chemical carcinogenesis to photosynthesis to configurational tunneling in glasses at very low temperatures. A brief introduction to elementary principles is given by way of their most recent work on FLN analysis of DNA damage from carcinogenic PAH metabolites. For this problem, a detectability of 1 damaged base pair: 10^8 for $\sim$ 10 μg of DNA at a spectral resolution of $\sim$ 5 cm^{-1} is required. Progress towards this detection limit is reported. Novel results on the application of PHB and NPAB to photosynthetic antenna and reaction center protein complexes of photosynthetic bacteria (R. viridis, R. sphaeroides) and green plants (photosystem I) are reported. The high resolution hole spectra provide valuable information on excitation and electron transfer dynamics, electron-protein coupling and excited electronic state structure.

37061 **Resonance enhanced multiphoton ionization/fluorescence for the characterization of complex organic samples.** Weeks, S.J.; D'Silva, A.P. (Iowa State Univ., Ames (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

The characterization of complex organic samples utilizing a multi-dimensional instrument band on resonance enhanced multiphoton ionization (REMPI) will be described. The instrument combines: (1) high resolution chromatography (HRC); (2) tunable UV laser excitation/ionization; (3) time-of-flight mass spectrometry (TLFMS); (4) total electron current detection; and (5) laser induced fluorescence spectrometry. The selectivity of REMPI and the simultaneous detection of cations, electrons and photons allows for the unequivocal characterization of each eluant isolated from a complex mixture by high resolution chromatography. The applications of the technique will be documented from data obtained from the characterization of samples of environmental and biological origin.

37062 **Luminescence spectroscopy and its application to antibody-based fiberoptics sensor.** Vo-Dinh, T.; Tromberg, B.J.; Griffin, G.D.; Sepaniak, M.J.; Ambrose, K.R. (Oak Ridge National Lab., TN (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

The integration of fiberoptics technology and advanced optical sensor promises to open new horizons in medical, clinical and environmental monitoring applications. In the area of human health protection against environmental pollutants, there is a strong need for sensitive and selective instrumentation to analyze complex biological samples. This paper describes the principle and applications of immunofluorescence spectroscopy to the development of antibody-based fiberoptics sensors. Special focus is devoted to a new antibody-based fiberoptics biosensor recently developed to detect the important carcinogen benzo(a)pyrene (BaP). The fiberoptics sensor utilizes anti-BaP antibodies covalently bound to its tip. A helium cadmium laser was used as the excitation source to induce fluorescence from BaP conjugated to the bound anti-BaP antibodies. The fiberoptics device can detect 1 femtomole of BaP in a 5-μL sample drop.

37063 **Fiber optics-based time resolved fluorimetry for immunoassays.** Sepaniak, M.J.; Petrea, R.D.; Vo'Dinh, T. (Univ. of Tennessee, Knoxville (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

A number of fiber optic-based devices have been developed for bioanalyses, including probes for performing fluoroimmunoassays. Single-fiber probes possess the advantages of good signal collection efficiency and small size, but suffer from high optical background levels. Rare earth metal chelate fluorescent labels for immunoassays have extremely long lifetimes and permit the effective use of time resolved detection to reduce the optical background and, thereby, improve detectability. The instrumentation and methodologies associated with the use of fiber optics-based time resolved fluorimetry will be described. The limit of detection for Eu-2-naphthoyltrifluoroacetone is nearly three orders of magnitude lower than for the most common fluorescent label, fluorescein isothiocyanate. Commercially available Eu-chelate labeled reagents are used to demonstrate the potential utility of time resolved fluorimetry for fiber optics-based immunoassays.

37064 **Novel approach for spatially and temporally resolved mapping of transient events.** Yappert, M.C.; Yeung, E.S.; Kimbrell, S.M. (Univ. of Louisville, KY (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

A new two-dimensional mapping technique has been developed and applied to the study of laser generated plumes. Two acousto-optical deflectors, arranged in tandem, allow the scanning of a laser beam in orthogonal directions without mechanical movement. The ability to scan these deflectors very rapidly (10^5-10^6 Hz) allows the completion of a scan in periods as short as 50 μs, while providing a spatial resolution of 20 x 125 spots. For such a time frame it is possible to study the formation and decay of atomic or molecular populations generated by laser vaporization from a surface. Both Na atoms and Pb_2 dimers have been monitored by absorption over the lifetime of the plume. For the first time, frozen, two-dimensional images have been obtained at different times during the evolution of a single event.

37065 **Prediction of GC-FID response as a function of molecular structure.** Jorgensen, A.D.; Picel, K.C.; Vlastnik, V.J.; Stamoudis, V.C. (Allegheny College, Meadville, PA (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

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The authors have been involved in the quantitative chromatographic characterization of complex mixtures, including synthetic fuels. Flame-ionization detector response factors are needed to relate detector signals to component concentration. For many years these factors have been predicted using rough guidelines based on molecular structure in lieu of analyzing individual standards. For example, each nitrogen or oxygen atom reduces the peak area by the equivalent of about one carbon atom. This work critically reexamines these guidelines using an internal standard and modern instrumentation, i.e. cold on-column injection into fused silica capillary columns. The results indicate that good predictions can be made in a reliable fashion. For the 72 compounds studied, most predicted relative response factors are within 2% of the observed value. This is a significant improvement over previous work and in many cases it can replace the need for the detailed analysis of standards. Classes studied include amines, nitrogen heterocycles, ketones, acetates, alcohols and phenols.

37066 **Nonaqueous sedimentation field-flow fractionation of inorganic particles.** Jones, H.K.; Robertson, D.M.; Yonker, C.R. (Pacific Northwest Lab., Richland, WA (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—). Contract AC06-76RL01830.

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

Characterization of inorganic particles by sedimentation field-flow fractionation (SdFFF) in organic carrier liquids offers an alternative to characterization in aqueous carriers. The densities of inorganic particles span a wide range (2 < rho/sub p/ < 10 gml). Ethanol (rho/sub s/ = 0.8 gml) and mixtures of ethanol and 1,1,2-trichlorotrifluoroethane (max. rho/sub s/ = 1.1 gml) were used in the analysis of silica particles by SdFFF. Organic liquids with densities as high as 3.0 gml could be exploited. Experimental studies with silica particles retained in a pure ethanol carrier gave results in good agreement with theoretical values. Another study with silica particles was performed in which the carrier liquid density was increased by stepwise addition of 1,1,2-trichlorotrifluoroethane to ethanol. The results show the feasibility of size and density characterization of inorganic particles in organic mixtures by SdFFF. The availability of high and low density miscible organic liquids makes carrier density programming a viable option along with the established programmed centrifugal field SdFFF.

37067 **Positron annihilation spectroscopy.** Dale, J.M.; Hulett, L.D. Jr.; Rosseel, T.M. (Oak Ridge National Lab., TN (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—). Contract AC05-84OR21400.

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

Positron annihilation spectroscopy (PAS) is a nondestructive technique that can be used for characterizing solid surfaces, defects in solids, or free volume in amorphous polymers. PAS is used in this work to investigate some positron annihilation characteristics of carbon fibers, epoxy polymers, and carbon-epoxy composites. They find that PAS is capable of detecting different concentrations of carbon fibers in composites. A relationship is shown to exist between fiber fractions found by PAS and apparent volume fractions found by density measurements. Positron annihilation centers have also been found that appear to have been created at the carbon-epoxy interface when the composite was prepared. Characterization of this interface is important for the development of composites with improved mechanical properties.

37068 **Colorimeter determination of Fe(II)/Fe(III) ratio in glass.** Baumann, E.W.; Coleman, C.J.; Karraker, D.G.; Scott, W.H. (E. I. du Pont de Nemours and Co., Aiken, SC (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—). Contract AC09-76SR00001.

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

A colorimetric method has been developed to determine the Fe(II)/Fe(III) ratio in glass containing nuclear waste. Fe(II) is stabilized with pentavalent vanadium during dissolution in sulfuric and hydrofluoric acids. The chromogen is FerroZine (Hach Chemical Company), which forms a magenta complex with Fe(II). The two-step color development consists of determining the Fe(II) by adding FerroZine, followed by determining total Fe after the Fe(III) present is reduced with ascorbic acid. The method was validated by analyzing mixtures of ferrous/ferric solutions and nonferrous glass frit, and by comparison with Moessbauer spectroscopy. The effect of gamma radiation was established. The procedure is generally applicable to nonradioactive materials such as minerals and other glasses.

37069 **(DP-tr—103) Studies on selective adsorption resins (12): Preparation of resins for adsorbing uranium in sea water.** Egawa, Hiroaki; Harada, Hiroshi; Nonaka, Takamasa. Translated from Nippon Kagaku Kaishi *Nippon Kagaku Kaishi ;* **11**: 1767-1772(1980). Contract AC09-76SR00001. 13p. Q/MF A01;1.

A study was perfomed with the aim of synthesizing resins for selectively adsorbing uranium for sea water. It was discovered that resins containing amidoxime groups (RNH), obtained by reacting acrylonitrile-divinylbenzene copolymer beads (RN) having a macroreticular (MR type) structure with hydroxylamine show good adsorbability of uranium in sea water. RN obtained by using 80–100 vol % toluene per monomer and 10–16 mol % divinylbenzene at the time of charging was found to be suitable as a substrate for obtaining resins with good uranium adsorbability; the copolymer beads had an average pore radius of 160–200 A, a specific surface area of 100–130 m^2/g, and a pore volume of about 0.4–0.7 ml/g. It was shown that RNH which was excellent for adsorbing uranium from sea water can be synthesized by adding a 3–5% methanol solution of hydroxylamine to RN at 1–1.5 moles per nitrile group and reacting at 60{degree}C for 3–5 hours or at 80{degree}C for 1–2 hours. 11 refs., 5 tabs.

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REFER ALSO TO CITATION(S) 35583, 35604, 35905, 35924, 36181, 36874, 36916, 36917, 36932, 36933, 36937, 36942, 36944, 37041, 37052, 37182, 37328, 37640, 37641, 37643, 37701, 37747

37070 **(AEEW-R—2276) Dynamic light scattering studies of polymers in solution I: polyacrylamides.** Benson, C.G. (UKAEA Atomic Energy Establishment, Winfrith). Oct 1987. 31p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Dynamic light scattering was used to investigate the behaviour of two grades of polyacrylamides both of different molecular weights (Alcoflood polyacrylamide 935 and 1175) dissolved in typical brine solution. Measurements were made initially at 90/sup 0/ scattering angle and the results used to provide a qualitative assessment of two methods of data analysis (ie method of cumulants and exponential sampling) which can be used to determine mean particle size. The semi-dilute regime is considered to be the range of concentrations in which interactions between polymer molecules become significant but without the formation of gel species. The semi-dilute behaviour of both polymers in the concentration range from 200 ppm to 1000 ppm was examined. The distribution mean particle size was measured for both polymers at different scattering angles in the range from 20/sup 0/ to 140/sup 0/. Diffusion coefficients for both polymers were measured over a range of different angles and concentrations. A study of the degradation of both polymers over a period of time showed the formation of large particulate species.

37071 (AEEW-R—2291) Dynamic light scattering studies of polymers in solution II: xanthan. Benson, C.G. (UKAEA Atomic Energy Establishment, Winfrith). Nov 1987. 15p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Dynamic light scattering was used to study the behaviour of the polysaccharide, xanthan dissolved in typical brine solutions. Measurements were made at 90/sup 0/ scattering angle on a 200 ppm xanthan solution. The distribution mean particle size was found to be 110 nm using the exponential sample method of data analysis, the distribution being bimodal in form. A 600 pm microgel free solution also gave similar results suggesting that neither of the components of the distributions were due to microgels. A comparison was also made of method of cumulants and exponential sampling techniques of data analysis, both of which can be used to measure mean particle size. The exponential sampling method was found to give the most accurate results. The semi-dilute behaviour of xanthan was studied in the concentration range from 200 ppm to 4000 ppm. A significant dependence of distribution mean particle size on concentration was found in the range 400 ppm to 4000 ppm, suggesting that the value of the critical concentration was between 300 ppm and 400 ppm. When the individual components of each bimodal distribution were examined, it was found that the position of the maximum of the smaller component remained essentially constant, whereas that of the larger component increased with concentration.

37072 (AERE-R—12950) Swept frequency measurement and analysis of microwave reflections from solvent layers on a water surface. Plested, G.N.; Flemming, M.A.; Hellier, A.N. (UKAEA Harwell Lab. Instrumentation and Applied Physics Div.). Mar 1988. 26p. H.M. Stationery Office, London, price Pound 4.00.

Microwave reflections from a solvent layer floating on a water surface have been analysed and measured, for a range of solvent layer thicknesses. The benefits of making swept-frequency measurements using a vector network analyser have been demonstrated. The results show that by monitoring surface reflections close to the Brewster angle for water, a system can be produced that will measure solvent layers down to thicknesses of 0.1 mm.

37073 (CEGB-TPRD/B—1011/R87) Reanalysis of oxide solubility data: results for nickel oxide and magnetite. Thornton, E.W.; Walker, S.M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1987. 55p. (PWR-CWG-P—88-539). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753607/JAW.

The analysis of oxide solubility data in high temperature water is discussed and attention drawn to (i) the need to use self-consistent sets of thermodynamic assumptions when intercomparing different studies and (ii) the importance of writing chemical equations involving ionic solution species in the correct manner (balancing like charges) if extrapolation to temperatures outside the range over which data were acquired is to be reliable. Literature solubility data for nickel oxide and magnetite are reanalysed, paying particular attention to uncertainties in the pH of minimum solubility and the magnitude and sign of the temperature coefficient of solubility at temperatures appropriate to the PWR primary circuit, around 300°C.

37074 (CONF-880435—7) Multiphoton ionization of transient species in supersonic jets. Miller, J.C.; Feigerle, C.S. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008366/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

A series of experiments utilizing mass-resolved multiphoton ionization to study NO diluted into supersonic beams of rare gases is presented. The sensitivity of the technique is demonstrated by the detection of 10/sup 3)-10{sup 4/ molecules of the rare isotopic combination $^{15}N^{16}O$ in its natural abundance. New results are given on the spectroscopy and photophysics of the Ar-NO, Kr-NO, and Xe-NO van der Waals molecules present in the beam. Finally, the addition of an electron beam or glow discharge at the orifice of the supersonic nozzle results in the formation of metastable rare gas atoms, sputtered metal atoms, and vibrationally hot NO molecules. 18 refs., 4 figs.

37075 (CONF-880543—1) Theoretical studies of chemical reactions: dynamics. Wagner, A.F.; Davis, M.J.; Schatz, G.C.; Duchovic, R.J.; Steckler, R. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011994/JAW.

From Basic energy sciences combustion contractor's meeting; Lake Geneva, WI, USA (31 May 1988).

Theoretical studies have been performed on the dynamics of interesting chemical reactions. The systems studied included the recombination reaction of methyl radicals to form ethylene, the addition of hydrogen atoms to carbon monoxide and the thermal dissociation of the formyl radical, the reaction of two hydroxyl radicals to form water and atomic hydrogen, the reaction of atomic chlorine with hydrogen chloride, and the intramolecular dynamics of highly excited OCS.

37076 (CONF-8804117—2) The adherence of nickel oxide on nickel during high temperature oxidation. Liu, Yung Y.; Natesan, K. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 12p. (CONF-8804117—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011194/JAW.

From Adhesion in solids; Reno, NV, USA (5 Apr 1988).

A combined experimental/analytical study is being conducted to investigate the fundamental nature of adherence of oxide scales formed on metals during high-temperature oxidation. Isothermal oxidation experiments were conducted on high-purity nickel (Ni 270) specimens in air at temperatures of up to 1200{degree}C. None of the experiments resulted in physical separation of nickel oxide scales from nickel substrate, even though substantial amounts of porosity were found in scales close to the scale/metal interfaces. The results of numerical and analytical calculations of stresses in the NiO/Ni system suggest that metal and oxide plasticities play a role in the experimental observations. 10 refs., 5 figs., 2 tabs.

37077 (CONF-8806137—1) Kinetics of iodine hydrolysis in unbuffered solutions. Palmer, D.A.; Lyons, L.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011379/JAW.

From 2. C.S.N.I. workshop on iodine chemistry; Toronto, Canada (2 Jun 1988).

The kinetics of hydrolysis or disproportionation of hypoiodite were studied spectrophotometrically in basic solution at an ionic strength of 0.2 M as a function of pH, iodide and total iodine concentration, and temperature. The existence of three independent pathways for this second-order process was confirmed. The pH-stat method was used to monitor the corresponding reaction of hypoiodous acid in weakly alkaline solution. The generalized rate law for the disproportionation is: {minus}d([HOI] + [OI/sup {minus/}])dt = k /sub a/[HOI]^2 + k/sub b/[HOI] [OI/sup {minus/}] + k/sub c/[OI/sup {minus/}]^2 + k/sub d/[I_2OH/sup {minus/}] [OI/sup {minus/}]. The values of k/sub a/ and k/sub b/ are substantially smaller than previously reported. However, an unexplained contribution to the rate law resulting from the pH-stat measurements was also obtained. The rapid recombination of iodide and iodate in $HClO_4$ solutions was followed by stopped-flow spectrophotometry at three ionic strengths, and over a range of iodide and hydrogen ion concentrations, and at eight temperatures. Fifth-order kinetics were observed with no detectable induction period. 14 refs., 4 figs., 1 tab.

37078 (DOE/ER/04447—235) Raman and absorption spectrophotometric studies of selected lanthanide, californium-doped lanthanide, and actinide trihalides in the solid state. Wilmarth, W.R. (Tennessee Univ., Knoxville (USA)). Mar 1988. Contract AS05-76ER04447;AC05-84OR21400. 131p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88008234/JAW.

The solid-state absorption spectra of Cf(III) ions as a dopant in lanthanide trihalide hosts ($LnCl_3$: Ln = Ce, Sm, and Y; $LnBr_3$:

Ln = Ce, Sm, Tb, and Y; LnI_3: Ln = Ce and Y) have been recorded. The spectra of Cf(III) have been correlated with the various crystal structures. The phonon Raman spectra and solid-state absorption spectra of PmF_3, $PmCl_3$, $PmBr_3$, and two crystal modifications of PmI_3 have been recorded. Symmetry assignments have been made for the Raman-active bands for these trihalides and also the sesquioxide. The room-temperature absorption spectra have been correlated to crystal field effects. The symmetry assignments of the Raman-active phonon modes have been made based on polarized Raman spectra from single crystals of YF_3-type orthorhombic TbF_3 and $PuBr_3$-type orthorhombic $NdBr_3$. Raman spectra of other isostructural lanthanide compounds have been recorded and compared. Symmetry assignments for these compounds have been made by analogy to the single-crystal assignments. Raman spectra have been obtained and catalogued for a number of actinide compounds. Symmetry assignments have been made for the observed Raman-active phonon bands in this work based on the assignments made for isostructural lanthanide compounds. 29 figs., 22 tabs.

37079 **(DOE/ER/04447—237) Raman spectrometric studies of selected lanthanide tribromides and trichlorides.** Daniel, J.F. (Tennessee Univ., Knoxville (USA)). Mar 1988. Contract AS05-76ER04447;AC05-84OR21400. 77p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88008235/JAW.

Laser Raman spectroscopy was used to identify the crystal structures of lanthanide and actinide compounds. The phonon Raman spectrum is characteristic of the particular crystal structure. $GdCl_3$ exhibits two crystal structures, the UCl_3-type hexagonal and the $PuBr_3$-type orthorhombic. In the literature it is reported that the low temperature form is orthorhombic; results of experiments here suggest that it is hexagonal. Interconversion between these two forms can be accomplished with temperature andor pressure. In the present work laser Raman spectrometry was used to monitor crystal structure changes in $GdCl_3$ as a function of temperature or pressure to determine the temperature or pressure at which the hexagonal-to-orthorhombic transformation occurs. Raman spectroscopy was also used to determine the symmetry assignments for the Raman-active bands of a single crystal. Raman spectra of polycrystalline $NdBr_3$ have been recorded at room temperature and pressure and at approximately 100{degree}K. In addition, polarized Raman spectra of a single crystal $NdBr_3$ have been measured. Based on these polarization measurements, symmetry assignments of eight Raman-active modes were made. These assignments are useful in interpreting the phonon Raman spectrum of any compound exhibiting the $PuBr_3$-type orthorhombic structure. 24 figs., 5 tabs.

37080 **(DOE/ER/13406—3) Organometallic chemistry of heterobimetallic compounds: Final report for the period August 1, 1985-June 30, 1988.** Casey, C.P. (Wisconsin Univ., Madison (USA). Dept. of Chemistry). Mar 1988. Contract FG02-85ER13406. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011570/JAW.

Work is reported on the following: formyl compounds, cyclopentadienyl ring slippage, μ-hydrocarbyl diiron complexes, heterobimetallic compounds linked by heterodifunctional ligands, heterobimetallic dihydrides, reactions of heterobimetallic dihydrides, early-late transition metal bimetallic compounds, and heterobimetallic μ-alkylidene complexes. (DLC)

37081 **(DOE/ER/13617—2) Selective transformation of carbonyl ligands to organic molecules: Progress report for period September 1, 1987-August 31, 1988.** Cutler, A.R. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Chemistry). 1988. Contract FG02-86ER13617. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009203/JAW.

We are interested in devising novel carbonylation procedures that convert alkyl complexes into their acyl derivatives. Alkyl complexes containing α-alkoxy or other oxy functionalities are especially of interest, since the alkyl-CO migratory-insertion step is central to converting synthesis gas to organic molecules with homogeneous catalysts. In our studies methoxymethyl complexes are used as model substrates. The presence of a methoxy group on methoxymethyl complexes kinetically retards their carbonylation. Our objective is to develop synthetic procedures that promote this reaction. Coordinated ligand reactions are also discussed. 20 refs.

37082 **(GKSS—87/E/41) RO-module with ultrasonic welded membranes.** Patocka, F.; Fries, S.; Timm, H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1987. 9p. Special print from Desalination (1987) v. 64 p. 423-430.

A new RO-module (K-module) with ultrasonic welded membranes is presented. The text describes the K-module in operation, design, advantages and experience.

37083 (INIS-BR—1075, pp 10) **Phase transition in chromium and chromium-vanadium alloys.** Castro, E.P.; Marques, G.E.; Camargo, P.C. de. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

37084 (INIS-mf—11227, pp 31-39) **Manufacture of cerium oxide-based polishing powders.** Janos, P.; Novak, J.; Broul, M.; Loucka, T. (Vyzkumny Ustav Anorganicke Chemie, Usti nad Labem (Czechoslovakia)). 15 May 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702876/JAW. (CONF-8704300—).

From 2. conference on rare earths; Mikulov, Czechoslovakia (28 Apr 1987).

Briefly described is the preparation of hydroxides, oxalates, and carbonates of rare earth elements for the production of polishing powders. Discussed are the effects of praseodymium, a type of compound which decomposes in the heat, and the temperature during calcination, on the properties of polishing powders. These powders were manufactured in different ways and their properties were compared with imported powders. Their polishng properties were tested. (E.S.). 1 fig., 3 tabs., 15 refs.

37085 **(IPEN-Pub—122) Determination of separation factors of Tb and Yb in binary mixtures of extractants.** Favaro, D.I.T.; Atalla, L.T. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Sep 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702399/JAW.

The values obtained for the separation factors of Tb and Yb, in nitric medium, using binary mixtures of HDEHP(di-12-ethylhexyl) phosphoric acid, HTTA (thenoyltrifluoroacetone), TBP (tributylphosphate) and TOPO (tri-n-octylphosphine oxide) were calculated. It was observed, from the results obtained, that the separation factor between Tb and Yb is not improved by the presence of the second extractor, not even when the synergistic effect occurs.

37086 **(LA—11291-PR) Isotope and nuclear chemistry division. Annual report, FY 1987. Progress report, October 1986-September 1987.** Barr, D.W.; Heiken, J.H. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 289p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88011880/JAW.

This report describes progress in the major research and development programs carried out in FY 1987 by the Isotope and Nuclear Chemistry Division. The report includes articles on radiochemical weapons diagnostics and research and development; other unclassified weapons research; stable and radioactive isotope production and separation; chemical biology and nuclear medicine; element and isotope transport and fixation; actinide and transition metal chemistry; structural chemistry, spectroscopy, and applications; nuclear structure and reactions; irradiation facilities; advanced concepts and technology; and atmospheric chemistry.

37087 **(LBL—25240) Tris[bis(trimethylsilyl)amido]uranium: Compounds with tri-, tetra-, and penta-valent uranium.** Stewart, J.L. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 200p. NTIS, PC A10. Order Number DE88010356/JAW.

This trivalent uranium compound, serves as a precursor to new tri-, tetra-, and penta-valent uranium species. The geometry about the U atom is pyramidal. Lewis-base coordination compounds of $U[N(SiMe_3)_2]_3$ with a one-to-one- ratio of Lewis base to

uranium were isolated with pyridine, 4-dimethylamino-pyridine, 2,6-Me_2-C_5H_3NC, and TPO. Two-to-one coordination compounds were obtained with t-butylnitrile and t-butylisocyanide. Compounds with more sterically demanding bases could not be isolated. The expected decrease in U-N($SiMe_3$)$_2$ bond length with increase in oxidation state is not observed. Reaction of ClU[N($SiMe_3$)$_2$]$_3$and Li[NH(p-tolyl)] yields the uranium (IV) dimer, U_2[N($SiMe_3$)$_2$]$_4$[μ-N(p-tolyl)]$_2$. Reaction with 2,4,6-triemethylaniline produces a dimer. Analogous substitution products could not be obtained with aniline or p-toluidine. t-Bu_3CO/sup {minus/}, t-Bu_3CHO/sup {minus/}, and t-Bu_3SiO/sup {minus/} are used to synthesize new tetravalent, mononuclear uranium compounds. Reaction of ClU(tritox)$_3$ with alkyllithium reagents leads to isolation of RU(tritox)$_3$. The reaction of U(ditox)$_4$ with MeLi affords the addition product U(ditox)$_4$(Me)Li, whose crystal structure is described. Preparation of uranium silox compounds is reported. 97 refs., 26 figs., 39 tabs.

37088 **(LBL—25330) Near-critical NaCl-H_2O: an equation of state and discussion of anomalous properties.** Pitzer, K.S.; Tanger, J.C. IV. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 35p. (CONF-880606—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012029/JAW.

From 10. symposium on thermophysical properties; Gaithersburg, MD, USA (20 Jun 1988).

The system NaCl-H_2O near the critical point of pure water shows not only the remarkable properties of any two-component system near the critical point of one component but also an anomalous curvature of the T-x and P-x projections of the critical line in the range below mole fraction 0.0005. An equation of state is presented which is based on the Haar-Gallagher-Kell equation for pure water with a few terms involving the mole fraction of NaCl together with the temperature and density. Parameters in this equation were selected which yield a good representation of the entire vapor-liquid coexistence surface from 250 to 600°C and from the three-phase pressure to the critical pressure (or t the vapor pressure of pure water below its T/sub c/). Derivatives of this equation yield densities, enthalpies, and heat capacities which are compared with experimental data. Also, the properties calculated for the vapor near the three-phase line are compared with those predicted by the successive hydration model previously developed for NaCl in steam in equilibrium with solid NaCl. Other related topics are discussed, including the anomalous features noted above.

37089 **(NIIAR—14(725)) Investigation into the efficiency of vacuum-distillation cleaning of ditolylmethane coolant.** Rozhdestvenskaya, L.N.; Tebelev, L.G.; Romanova, Z.M.; Benderskaya, O.S.; Simonov, Yu.G.; Sidorov, V.V.; Pochechura, V.P. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702950/JAW.

The efficiency in cleaning the ditolymethane reactor-coolant at the vacuum distillation units is shown. The diagrams of the units are presented and the choice of the distillation mode substantiated. The basic operations of the process are enumerated. It has been demonstrated that the above units meet the requirements of the reactor-coolant cleaning from the high-boiling thermoradiolysis products. Some additional and more efficient methods are needed for a complete removal of iron, chloride, oxygen-containing impurities out of ditolylmethane. 9 refs.; 8 figs.; 3 tabs.

37090 **(PNL-SA—15499) Rate expressions for abstraction of hydrogen atom from a molybdenum hydride by alkyl radicals.** Linehan, J.C.; Alnajjar, M.S.; Franz, J.A. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 9p. (CONF-880604—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011897/JAW.

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

Rate expressions were determined for the abstraction of hydrogen atom from pentamethylcyclopentadienyltricarbonyl-molybdenum hydride ($Me_5CpMo(CO)_3H$). The radical clocks hept-6-en-2-yl, produced from bromine atom abstraction from 7-bromoheptene, and hex-5-enyl, produced from bromine atom abstraction from 6-bromohexene, were utilized to compete intramolecular cyclization (kcyc) with bimolecular abstraction (kabs) from $Me_5CpMo(CO)_3H$ in n-octane. Using known rate expressions for the cyclization of the primary clock, and separate rate expressions for cyclization of the secondary clock to give cis- and trans-cyclized products, rate expressions for abstraction were developed from ratios of unrearranged and rearranged hydrocarbon products. For the primary clock, log(kabs/$M^{-1}s^{-1}$) = 9.0 +/- 0.3 - (0.93 +/- 0.2)/theta, theta = 2.3RT kcal/mole, kabs = 2.1 x 10^8 $M^{-1}s^{-1}$. For the secondary clock, log(kabs/$M^{-1}s^{-1}$) = 8.6 +/- 0.3 -(0.81 +/- 0.1)/theta, and kabs = 1.0 x 10^8 $M^{-1}s^{-1}$. The bimolecular rates are slower by a factor of ten than expected for diffusion control. The activation barriers are lower than activation barriers expected for diffusion-controlled hydrogen abstraction by ca. 1.5 kcal/mole. The results are discussed in terms of the thermochemistry of the reactions and in terms of rates of biomolecular reactions approaching diffusion control. The synthetic utility of the reduction reaction is discussed.

37091 (RISO-M—2630, pp 16-23) **Reactions of hydroxyl radicals with compounds of group IV elements.** O'Farrell, D.; Treacy, J.; Sidebottom, H. (Dublin Istitute of Techology (IR); University College Dublin (IR)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37092 (RISO-M—2630, pp 24-28) **Absorption spectrum and kinetics of the acetylperoxy radical.** Moortgat, G.K.; Veyret, B.; Lesclaux, R. (Air Chemistry Department, Max-Planck-Institut fuer Chemie, Mainz (DE); Universite de Bordeaux 1, Laboratoire de Photophysique et de Photochimie moleculaire, Talence, Cedex (FR)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37093 (RISO-M—2630, pp 68-78) **Heterogenous reactions of nitrogen compounds: A study of the decomposition kinetics of HNO_3.** Svensson, R.; Ljungstroem, E. (Department of Inorganic Chemistry, Chalmers University of Technology and University of Goeteborg, Goeteborg (SE)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

The rate of thermal decomposition of HNO_3 has been measured by FTIR spectroscopy. The measurements were made in a teflon lined batch reactor with a surface to volume ratio of 14 m^{-1}. The experiments were made with initial HNO_3 concentrations of between 2 and 12 ppm. At atmospheric pressure, HNO_3 decomposes into NO_2 and other products with a first order HNO_3 dependence and with a rate constant, describing the process in our equipment, of 2.1(+-0.3) 10^{-3} min^{-1}. There are strong indications that the decomposition proceeds heterogenously. 11 refs.

37094 (RISO-M—2630, pp 96-99) **Laser absorption study of the reactions of the NO_3 radical with CL and HO_2.** Hoffmann, A.; Zellner, R. (Institut fuer Physikalische Chemie, Universitaet Goettingen (DE)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37095 (RISO-M—2630, pp 100-102) **Kinetics of the reaction of NO_3 with HO_2.** Hall, I.W.; Wayne, R.P.; Cox, R.A., Jenkin, M.E.; Hayman, G.D. (Physical Chemistry Laboratory, University of Oxford (GB); Harwell Laboratory, Didcot, Oxfordshire (GB)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37096 (RISO-M—2630, pp 103-106) **Determination of absolute rate constants for the reaction of NO_3 radicals with substituted olefins.** Schindler, R.N. (Kiel (DE)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37097 (RISO-M—2630, pp 107-116) **FT-IR studies of reactions of the NO_3 radical: CH_2O, β-pinene.** Hjorth, J.; Ottobrini, G.; Restelli, G.; Skov, H. (Joint Research Centre - Ispra Establishment I (IT)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37098 (RISO-M—2630, pp 133-141) **Kinetic studies, under simulated atmospheric conditions, of nitrate radical reactions with various organics.** Carlier, P.; Hannachi, H.; Kartoudis, A.; Martinet, A.; Mouvier, G. (Laboratoire de Physico-Chimie de l'Atmosphere, associe au CNRS, Universite Paris 7, Paris (FR)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37099 **Vibration—rotation spectrum of the carbon dioxide—acetylene van der Waals complex in the 3 μ region.** Prichard, D.G.; Nandi, R.N.; Muenter, J.S.; Howard, B.J. (Department of Chemistry, University of Rochester, Rochester, New York 14627). *Journal of Chemical Physics;* **89**: No. 3, 1245-1250(1 Aug 1988).

The infrared absorption spectrum of the carbon dioxide—acetylene van der Waals complex has been observed in a pulsed molecular beam. A color center laser was used to excite the vibration associated with the antisymmetric hydrogen stretching mode of the acetylene monomer. The vibrational origin is 3281.740 cm^{-1} and the rotational constants are A" = 8876, B" = 2859, C" = 2155, A' = 8864, B' = 2855, and C' = 2154 MHz. The axes of the two monomer are parallel to one another and the complex has C_s/sub v/ symmetry. The separation of the monomer units is 3.285 A. The angular part of the intermolecular potential function is discussed in terms of electrostatic interactions between distributed multipole moments.

37100 **Fluorescence lifetime of excited cyclohexane in an argon matrix and in solid state cyclohexane at low temperature.** Preses, J.M. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **89**: No. 3, 1251-1254(1 Aug 1988).

Electronic fluorescence has been observed from cyclohexane isolated in an Ar matrix in the temperature range 16—30 K. Excitation spectra have been obtained, and the behavior of the fluorescence lifetime has been determined as a function of excitation wavelength. The variation of the fluorescence lifetime as a function of excitation wavelength in the matrix resembles that seen in the gas phase. The fluorescence of neat, solid cyclohexane has also been observed at low temperature, and its decay rate can be used to refine the parameters obtained near room temperature which describe the decay rate. The fluorescence lifetime (tau) of excited cyclohexane can be described by an expression of the form $1/tau = [4.1 \times 10^8 + 8.8 \times 10^{11} \exp(-4100/1.987\ T)]\ s^{-1}$.

37101 **Tunable far infrared laser spectroscopy of van der Waals bonds: Extended measurements on the lowest Σ bend of ArHCl.** Busarow, K.L.; Blake, G.A.; Laughlin, K.B.; Cohen, R.C.; Lee, Y.T.; Saykally, R.J. (Department of Chemistry and Materials and Chemical Sciences Division, University of California and Lawrence Berkeley Laboratories, Berkeley, California 94720). *Journal of Chemical Physics;* **89**: No. 3, 1268-1276(1 Aug 1988).

A tunable far infrared laser system has been used to measure the vibration—rotation spectrum of the lowest Σ bending state of ArHCl near 24 cm^{-1} in a cw planar jet operating with a terminal jet temperature near 3 K. Over 60 transitions have been observed for both ^{35}Cl and ^{37}Cl isotopes with resolution of the quadrupole hyperfine structure. An improved set of molecular parameters was determined, including B, D, H, and eqQ for both upper and lower states. Very narrow linewidths (approximately 300 kHz) resulting in high resolution and sensitivity make this technique a powerful new method for the detailed investigation of intermolecular forces.

37102 **Raman spectra of polycrystalline orthorhombic YF_3, SmF_3, HoF_3, YbF_3, and single crystal TbF_3.** Wilmarth, W.R.; Begun, G.M.; Nave, S.E.; Peterson, J.R. (Department of Chemistry, University of Tennessee, Knoxville, Tennessee 37996-1600). *Journal of Chemical Physics;* **89**: No. 2, 711-715(15 Jul 1988).

The Raman spectra of the orthorhombic form of polycrystalline YF_3, SmF_3, TbF_3, HoF_3, and YbF_3 have been recorded. Room-temperature, polarized Raman spectra of a single crystal of orthorhombic TbF_3 have also been obtained. Based on these polarized Raman spectra, symmetry assignments have been made for 23 of the expected 24 Raman active phonon vibrations in TbF_3. By analogy to the results from single crystal TbF_3, tentative symmetry assignments of the observed phonon vibrations were also made for the other compounds included in this work.

37103 **Metastable decay of photoionized niobium clusters: Clusters within a cluster?.** Cole, S.K.; Liu, K. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **89**: No. 2, 780-789(15 Jul 1988).

The photoinduced metastable ion fragmentation of niobium clusters has been found to closely correlate with the laser vaporization source conditions. The experimental evidence indicates the clusters agglomerate in the supersonic expansion. These agglomerated clusters exhibit rather unique behavior for a transition metal system. Both evaporation and fission fragmentation are observed. Two color MPI studies reveal the existence of long lived neutral intermediate states. Also, the kinetic energy release is extremely small, <10 meV, and independent of the excitation energy. The concept of clusters within a cluster, i.e., agglomerated clusters, is introduced to rationalize many experimental findings.

37104 **Autoionization dynamics in the valence-shell photoionization spectrum of CO.** Hardis, J.E.; Ferrett, T.A.; Southworth, S.H.; Parr, A.C.; Roy, P.; Dehmer, J.L.; Dehmer, P.M.; Chupka, W.A. (National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Chemical Physics;* **89**: No. 2, 812-819(15 Jul 1988).

Autoionizing Rydberg series in the valence-shell spectrum of CO have been studied by determining the high resolution relative photoionization cross section of cooled CO in the energy region 14.0—20.0 eV and by determining the vibrational branching ratios and the photoelectron angular distributions for production of CO^+ $X\ ^2\Sigma^+$, $v^+ = 0$—2 in the energy region 16.75—18.75 eV. Of particular interest are three prominent spectral features between 17.0 and 17.5 eV that result from interactions involving Rydberg series converging to the excited A ^{2}Pi and B $^2\Sigma^+$ states of the ion. The results are discussed in the context of recent two-step multichannel

quantum defect theory calculations by Leyh and Raseev (the following paper).

37105 **Calculation of the rate of entropy production for a model chemical reaction.** Irvin, B.R.; Ross, J. (Department of Chemistry, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* **89**: No. 2, 1064-1066(15 Jul 1988).

The rate of entropy production due to chemical reaction is calculated for a variety of parameter values in the reversible Oregonator model. The average values over cycles of oscillation are compared to those in the coexisting stationary states. The present work corrects an earlier calculation [A. K. Dutt, J. Chem. Phys. 86, 3959 (1987)]. Contrary to previous impressions and claims, there is no consistent relationship between the magnitudes of the entropy production in coexisting stationary and oscillatory states, in this case.

37106 **Analytic treatment of percolation in simple fluids.** Xu, J.; Stell, G. (Department of Mechanical Engineering, State University of New York at Stony Brook, Stony Brook, New York 11794). *Journal of Chemical Physics;* **89**: No. 2, 1101-1111(15 Jul 1988).

The percolation behavior of simple fluids, modeled by a pair potential with a hard core and Yukawa tail, is studied by solving the connectedness Ornstein—Zernike equation analytically in the mean-spherical approximation for two different connectedness models. The simplest connectedness model is defined by a "connectedness shell" concentric to the sphere that defines the hard core. The analytical solution applies to the case of the shell width less than the hard-core diameter, which is the case for most applications of physical interest. The percolation loci on the phase diagram have been determined along with the average coordination number, which is found to be essentially constant along each locus, but different for different loci. A second model is introduced in which direct connectedness-in-probability is defined and applied to the gelation problem. This model can be thought of as a continuum generalization of the lattice model of gelation introduced by Coniglio, Stanley, and Klein. In the mean-spherical approximation, the models have percolation exponents ($\beta = 1/2$, $\delta = 5$, $\gamma = 2$, eta = 0, fractal dimensionality = 2.5) that for the most part are quite close to the best available estimates of these exponents.

37107 **Electronic structure of Cs multilayer and monolayer adsorbed on Ru(001): A photoemission study.** Sham, T.K.; Hrbek, J. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **89**: No. 2, 1188-1194(15 Jul 1988).

The electronic structure of Cs adsorbed on Ru(001) at multilayer and monolayer coverages has been investigated with high resolution photoelectron spectroscopy (PES) using synchrotron radiation. It is found that at multilayer coverage, the electron distribution curve (EDC) of the Cs overlayer is essentially the same as that of the Cs metal reported previously except that, with the high resolution, a surface atom core-level (Cs $^{5}p_{3/2}$) binding-energy shift of +0.24 eV is observed for the first time. It is also found that at monolayer coverage which exhibits a (78 x 78)-R30° LEED pattern, the Cs $5p_{3/2}$ level shifts by 1.0 eV to lower binding energy relative to that of the multilayer; this shift is accompanied by a significant linewidth broadening and a nearly complete suppression of O_3VV Auger emission. These results are interpreted on the basis of the volume effect and a rehybridization mechanism in which the compression of the Cs atom and the interplay of conduction and 5d electrons at the Cs site are crucial to the 5p binding energy shift, core hole lifetime, and Auger transition.

37108 **Microwave and infrared studies of acetylene dimer in a T-shaped configuration.** Prichard, D.G.; Nandi, R.N.; Muenter, J.S. (Department of Chemistry, University of Rochester, Rochester, New York 14627). *Journal of Chemical Physics;* **89**: No. 1, 115-123(1 Jul 1988).

Radio frequency, microwave, and infrared spectra have been obtained from molecular beams of acetylene dimer. The geometry of the isomer studied here is T shaped, with the centers of mass of the monomers separated by 4.38 A. The equilibrium structure appears not to have C_2/sub v/ symmetry and the vibrationally averaged structure has the "top" of the T rotated about its center of mass by 27°. The electric dipole moment of this complex is 0.28 D.

37109 **Systematic theoretical study of harmonic vibrational frequencies: The single and double excitation coupled cluster (CCSD) method.** Besler, B.H.; Scuseria, G.E.; Scheiner, A.C.; Schaefer H.F. III. (Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **89**: No. 1, 360-366(1 Jul 1988).

Recently developed analytic CCSD gradient methods have been used to predictthe harmonic vibrational frequencies of six molecules: CH_4, NH^+_4,HCN, C_2H_2, HNC, and CO_2. In every case a double zeta plus polarization(DZ+P) basis set of size C,N,O(9s5p1d/4s2p1d), H(4s1p/2s1p) was used. Previous analogous studies of H_2O, H_2CO, and NH_3 are extended to form a statistical base of nine molecules. For these molecules 28 harmonic vibrational frequencies (out of total of 35 fundamentals) are thought to be known from experiment. The average errors with respect to experiment were found to be 9.1% (DZ+P self-consistent field), 3.7% (DZ+P configuration interaction including single and double excitations), and 2.2% (DZ+PCCSD). These statistics should provide guidance for the use of the CCSD method in situations where experimental vibrational frequencies are not available. Infrared intensities are also compared with available experimental data.

37110 **Unexpected hydrogen induced displacement of chemisorbed CO from the Ni(100) surface.** Shen, S.; Zaera, F.; Fischer, D.A.; Gland, J.L. (Chinese Academy of Science, Lanzhou Institute of Chemical Physics, Lanzhou, China). *Journal of Chemical Physics;* **89**: No. 1, 590-596(1 Jul 1988).

We report the first observation of hydrogen induced displacement of chemisorbed CO from the Ni (100) surface. This displacement is unexpected since the heat of adsorption for CO is 30 kcalmol, about 7 kcalmol larger than the 23 kcalmol heat of adsorption for hydrogen. These displacement studies were performed in a UHV system equipped with Auger electron spectroscopy and facilties for temperature programmed desorption. Rates of displacement were measured by integrating CO temperature programmed desorption spectra for a series of displacement times. Hydrogen pressures in the 10^{-5} to 10^{-4} Torr range cause displacement of chemisorbed CO in the 290 to 330 K temperature range in a matter of minutes. After displacement, the surface contained only undisplaced CO and adsorbed hydrogen. No surface contamination was detected following CO temperature programmed desorption. The displacement reaction is clearly positive order in CO coverage. The CO coverage data suggests two first order reaction regions with a decrease in rate with decreasing coverage. Displacement is about half-order in hydrogen pressure. For low CO coverages (below 0.3 to 0.4 monolayer) and 309 K the displacement probability is around 5×10^{-7} per incident H_2 molecule and has an activation energy of about 12 +- 1 kcalmol. At high coverages the displacement probability is about 1×10^{-6} per incident H_2 molecule and the activation energy decreases to about 8 +- 2 kcalmol. No CO displacement was observed in the 270 to 330 K temperature range for pressures up to 10^{-3} Torr of He, Ne, CH_4 or N_2. The CO displacement rate is also insensitive to deuterium substitution. The thermal activation energies measured indicate that the metal surface is furnishing 8 and 12 kcalmol for the displacement of high and low coverages of adsorbed CO, respectively.

37111 **Theoretical study of the energies of BH/sub n/ compounds.** Curtiss, L.A.; Pople, J.A. (Argonne National Laboratory, Chemical Technology Division/Materials Science Program, Argonne, Illinois 60439-4837). *Journal of Chemical Physics;* **89**: No. 1, 614-615(1 Jul 1988).

A study of the energies of BH/sub n/ compounds (n = 1—3), cations and neutrals, using high levels of ab initio molecular orbital theory, including correlation effects beyond fourth-order perturbation theory, is presented. The appearance potentials of BH^+, BH^+_2, and BH^+_3 are in good agreement with experiment. The results suggest that the experimental dissociation energy and ionization potential of BH may be in error.

37112 **2 + 1 REMPI spectra of cyclic ketones in a cold molecular beam. 2. The n → 3s Rydberg transition of methyl-substituted cyclohexanones and cyclopentanones.** Cornish, T.J.; Baer, T. (Univ. of North Carolina, Chapel Hill (USA)). *Journal of the American Chemical Society;* **110**: No. 10, 3099-3106(11 May 1988).

The two-photon excitation of the n → 3s Rydberg transition in monomethyl and dimethyl isomers of cyclohexanone and cyclopentanone has been studied by resonance enhanced multiphoton ionization (2 + 1 REMPI). This transition has been found to be highly sensitive to both the orientation and position of methyl substituents on the cyclic ketone ring. Cis and trans configurations of dimethyl isomers show characteristic 3s transition energy shifts which are additive in nature and can be used to predict the transition energy of other structures. The spectroscopic energies of configurational isomers appear to reflect relative ground-state stabilities. This correlation has been supported by thermodynamic data and molecular mechanics calculations of ground-state energies. Laser polarization effects are found to be useful in determining the degree of chromophore asymmetry in chiral molecules.

37113 **Kinetics and mechanism of the insertion of olefins into niobium- and tantalum-hydride bonds: a study of the competition between steric and electronic effects.** Burger, B.J.; Santarsiero, B.D.; Trimmer, M.S.; Bercaw, J.E. (California Institute of Technology, Pasadena (USA)). *Journal of the American Chemical Society;* **110**: No. 10, 3134-3146(11 May 1988). Contract FG03-85ER13431.

The mechanism of insertion of olefins into transition metal-hydride bonds has been examined for a series of olefin hydride complexes of niobocene, permethylniobocene, tantalocene, and permethyltantalocene. The insertion rates were measured for several meta-substituted styrene complexes of permethylniobocene and found to be comparable to those found for the para-substituted analogues, indicating that the electronic effects are largely inductive in origin. An X-ray crystal structure determination for the parent styrene complex (P/sub bca/; a = 14.626 (3) A, b = 18.134 (4) A, c = 18.147 (4) A; $\alpha, \beta, \gamma = 90°$) offers an explanation for this observation: the phenyl ring is bent out of resonance with the olefin π system by 32°. A comparison of the rates for the entire series of ethylene compounds (where steric effects are minimal) indicates that there are significant electronic effects acting within this family (k/sub Nb/ > k/sub Cp/; Cp = (eta^5-C_5H_5), Cp* = (eta^5-C_5Me_5)). In contrast to the pentamethylcyclopentadienyl systems for which steric interactions appear to dominate, the normal cyclopentadienyl compounds are virtually insensitive to sterics, allowing for the existence of two isomeric forms of the α-olefin hydride complexes (endo, olefin substituent central, and exo, olefin substituent lateral in the equatorial plane) in roughly 1:1 proportion.

37114 **Synthesis of boron carbide via poly(vinylpentaborane) precursors.** Mirabelli, M.G.L.; Sneddon, L.G. (Univ. of Pennsylvania, Philadelphia (USA)). *Journal of the American Chemical Society;* **110**: No. 10, 3305-3307(11 May 1988).

Limitations in traditional ceramic processing have encouraged interest in the development and utilization of polymer pyrolyses as low-temperature synthetic routes to nonoxide ceramic materials. Boron carbide is an example of a material where preparation from a polymer precursor might offer advantages over conventional synthetic techniques. Mixed B_4C-SiC ceramics have, in fact, been previously obtained from pyrolysis of poly(carboranesiloxane) polymers; however, a synthesis of pure B_4C from polymeric precursors has heretofore not been developed. They report here that 2-(H_2C=CH)-B_5H_8 will undergo thermal polymerization to vinylpentaborane oligomers and that these species can be converted to pure boron carbide (B_4C) in high ceramic yields under mild conditions.

37115 **New class of homoleptic 12-electron molybdenum and tungsten alkoxide clusters of formula $[M_4(OR)_{12}]$.** Chisholm, M.H.; Folting, K.; Hammond, C.E.; Hampden-Smith, M.J. (Indiana Univ., Bloomington (USA)). *Journal of the American Chemical Society;* **110**: No. 10, 3314-3315(11 May 1988).

The authors are interested in developing efficient synthetic routes to alkoxide-supported molybdenum and tungsten clusters that may prove to be excellent models for fragments of reduced oxides of the same metals. These clusters should include both coordinative unsaturation and redox flexibility at the metal centers to initiate organometallic chemistry upon substrate reduction. Complementary metal oxide model systems such as polyoxoanions may prove effective for oxidation catalysis. They have recently demonstrated that $W_2(O\text{-}i\text{-}Pr)_8$ (I) exists in reversible equilibrium with its 12-electron cluster $W_4(O\text{-}i\text{-}Pr)_{12}$ (II) in solution at room temperature, eq 1, whereas $Mo_2(O\text{-}i\text{-}Pr)_8$ is indefinitely stable with respect to cluster formation. Even by reducing the steric demands at the molybdenum center they were unable to induce the formation of new metal-metal bonds in $[Mo_2(O\text{-}i\text{-}Pr)_8(OMe)]_2$ (III), which instead retains isolated, unbridged Mo-Mo triple bonds. The authors report here the isolation and characterization of members of a new class of 12-electron tetranuclear alkoxide clusters, IV-XI, which are spectroscopically isostructural for both molybdenum and tungsten together with the single-crystal X-ray diffraction structure of one derivative, $[Mo_4(O\text{-}CH_2\text{-}c\text{-}Bu)_{12}(HO\text{-}CH_2\text{-}c\text{-}Bu)]$ (XI) (where c-Bu = cyclobutyl). This represents the first group of structurally related homoleptic alkoxide clusters for molybdenum and tungsten in oxidation state (3+).

37116 **Kinetic study of the formation of dihydrogen from the reaction of [1.1]ferrocenophanes with strong acids. 2. Tensiometry, spectrometry, and deuterium exchange studies.** Michaile, S.; Hillman, M.; Eisch, J.J. (Brookhaven National Lab., Upton, NY (USA)). *Organometallics;* **7**: No. 5, 1059-1065(May 1988). Contract AC02-76CH00016.

The kinetics of the reactions [1.1]ferrocenophane (I), 3,3'-trimethylene[1.1]ferrocenophane (II), and 2,2'-trimethylene[1.1]ferrocenophane (III) were studied by using tensiometric and spectrometric techniques at acid strengths that were lower than those used in the electrochemical investigation. The results of these measurements are consistent with the three-step mechanism proposed for the formation of dihydrogen: a very fast initial protonation, a slower second protonation, and the elimination of dihydrogen as the rate-determining step. However, at the lower acid strengths, competing reactions occur. One of these very likely involves the comproportionation of the ferrocenophane and the dication followed by the decomposition of the resulting monocation. The nature of other competing reactions remains as an open question. Kinetic studies using deuteriated acids established a primary kinetic isotope effect, k/sub H/k/sub D/, between 3 and 5, for compound I. The ring protons of the ferrocenophane undergo complete exchange in these media at a rate much faster than the rate for dihydrogen formation. No exchange of the methylene protons was observed.

37117 **Normal vibrational modes of buckminsterfullerene.** Stanton, R.E.; Newton, M.D. (Canisius College, Buffalo, NY (USA)). *Journal of Physical Chemistry;* **92**: No. 8, 2141-2145(21 Apr 1988). Contract AC02-76CH00016.

The MNDO approximation is employed to compute normal modes of vibration for the proposed C_{60} isomer known as buckminsterullerene. Group theoretical invariance theorems are derived to aid in the interpretation of the normal modes. One particularly interesting mode (the sole A/sub u/ vibration) consists of a rotary oscillation of the pentagonal rings of C_{60}, with all rings rotating in the same direction.

37118 **Kinetics of hydrogen and hydroxyl radical attack on phenol at high temperatures.** He, Y.Z.; Mallard, W.G.; Tsang, W. (National Bureau of Standards, Gaithersburg, MD (USA)). *Journal of Physical Chemistry;* **92**: No. 8, 2196-2201(21 Apr 1988).

The kinetics of hydrogen and hydroxyl radical attack on phenol have been studied in single-pulse shock tube experiments. The hydrogen atoms are formed through the unimolecular decomposition of hexamethylethane (C_8H_{18}) to two tert-butyl radicals which rapidly decompose to hydrogen atoms and isobutene. The hydrogen atoms react with phenol via abstraction of the phenolic hydrogen and displacement of OH. From the yields of isobutene and benzene the authors derive the ratio of the rate for these two processes over the temperature range 1000-1150 K and pressures between 2.5 and 5 atm. In the presence of added methane, benzene

yield is depressed due to the reaction of hydrogen with methane. Since the rate of H atom reaction with methane is known, the rate constant ratio can be used to derive absolute rate constants. Using a rate expression for $k(H + CH_4 \rightarrow CH_3 + H_2) = 2.4 \times 10^{11} \exp(-7000/T)$ L/(mol x s), they find $k(H + C_6H_5OH \rightarrow H_2 + C_6H_5O) = 1.15 \times 10^{11} \exp(-6240/T)$ L/(mol x s) and $k(H + C_6H_5OH \rightarrow C_6H_6 + OH) = 2.21 \times 10^{10} \exp(-3990/T)$ L/(mol x s). The substitution of large quantities of carbon monoxide in place of methane leads to increased yields of benzene. On the basis of $k(OH + CO \rightarrow CO_2 + H) = 7 \times 10^7 \exp(0.00092T)$ L/(mol x s), they find $k(OH + C_6H_5OH \rightarrow C_6H_5O + H_2O) = 6 \times 10^9$L/(mol x s) at 1032 K. From the equilibrium constant the rate expression for the displacement of a hydrogen atom by hydroxyl radical is $k(OH + C_6H_5OH) = 13.4 \times 10^9 \exp(-5330/T)$L/(mol x s).

37119 **Structural environments and oxidation states of metal cations in bismuth cerium molybdate solid solutions by x-ray spectroscopy.** Antonio, M.R.; Brazdil, J.F.; Glaeser, L.C.; Mehicic, M.; Teller, R.G. (BP America Research and Development, Cleveland, OH (USA)). *Journal of Physical Chemistry;* **92**: No. 8, 2338-2345(21 Apr 1988).

Bismuth and cerium L_3-edge and molybdenum K-edge X-ray absorption investigations of silica-supported bismuth cerium molybdates were undertaken to probe the local structural environments and oxidation states of the metal cations. A total of 10 single-phase compositions in the bimodal Bi/sub 2-x/Ce/sub x/$[MoO_4]_3$ solid solution (for $0 \leqq x \leqq 0.25$ and $1 \leqq x \leqq 1.5$) were examined; namely, x = 0, 0.025, 0.075, 0.125, 0.2, 0.25, 1, 1.125, 1.25, and 1.5. For low cerium concentrations ($x \leqq 0.25$), the Bi/sub 2-x/Ce/sub x/$[MeO_4]_3$ materials possess severely distorted defect-scheelite structure with cerium cations dissolved in the $Bi_2[MoO_4]_3$ (x = 0) lattice, whereas for high cerium concentrations ($x \geqq 1$), they possess undistorted defect-scheelite structures with bismuth cations dissolved in the $Ce_2[MoO_4]_3$ (x = 2) lattice. The EXAFS results provide the first quantitative structural information about the individual Bi^{3+} and Ce^{3+} sites in the Bi/sub 2-x/Ce/sub x/$[MoO_4]_3$ compositions for $0.025 \leqq x \leqq 1.5$; only site-averaged metrical parameters for an admixture of bismuth and cerium cation positions are available from X-ray and neutron diffraction measurements.

37120 **Intrinsic barriers to proton exchange between transition-metal centers: application of a weak-interaction model.** Creutz, C.; Sutin, N. (Brookhaven National Lab., Upton, NY (USA)). *Journal of the American Chemical Society;* **110**: No. 8, 2418-2427(13 Apr 1988). Contract AC02-76CH00016.

A weak-interaction model for proton self-exchange between transition-metal centers is considered. The rate constant obtained from the Fermi golden-rule expression of radiationless transition theory is a product of terms for assembling acid and base reactants at the correct orientation and distance, a classical reaction frequency, an electron-proton reaction probability, and classical nuclear factors deriving from the requirement for reorganization of ancillary ligands and solvent modes. It is found that such a model yields calculated rate constants and activation parameters in reasonable agreement with the experimental data, provided that the fluxionality of certain metal centers is taken into account.

37121 **Pressure effects on the intervalence-transfer band of salts of mixed-valence 1',1'''-disubstituted biferrocenium cations.** Sinha, U.; Lowery, M.D.; Ley, W.W.; Drickamer, H.G.; Hendrickson, D.N. (Univ. of Illinois, Urbana (USA)). *Journal of the American Chemical Society;* **110**: No. 8, 2471-2477(13 Apr 1988). Contract AC02-76ER01198.

The pressure dependence of the intervalence-transfer (IT) electronic absorption band has been determined for the mixed-valence biferrocenium and 1',1'''-diethylbiferrocenium cations intercalated into a clay and for the following eight microcrystalline compounds: biferrocenium triiodide (1); biferrocenium hexafluorophosphate (2); 1',1'''-diiodobiferrocenium triiodide (3); 1',1'''-diiodobiferrocenium dibromoiodate (4); 1',1'''-dibromobiferrocenium triiodide (5); 1',1'''-dichlorobiferrocenium triiodide hemiiodine (6); 1',1'''-diethylbiferrocenium triiodide (7); 1',1'''-di-n-butylbiferrocenium triiodide (8). Basically three different types of pressure dependencies of the energy of the IT band are seen. Compounds 3-5, which have a solid-state packing arrangement consisting of alternating stacks of cations and anions, exhibit one type of behavior. For these three compounds the IT band shifts blue initially with pressure, and above ~ 80 kbar there is the onset of a rather abrupt reversal where the IT band shifts red with increasing pressure.

37122 **Kinetics and mechanisms of α- and β-eliminations of alkoxysilanes from saturated and unsaturated carbon frameworks.** Bain, S.; Ijadi-Maghsoodi, S.; Barton, T.J. (Iowa State Univ., Ames (USA)). *Journal of the American Chemical Society;* **110**: No. 8, 2611-2614(13 Apr 1988).

Although $Me_3SiCH_2SiMe_2OMe$ undergoes thermally induced β-elimination of Me_3SiOMe to afford dimethylsilene, the thermodynamically favorable elimination of Me_3SiOMe from $Me_3SiSiMe_2CH_2OMe$ does not occur. From kinetic studies and trapping experiments, this is found to be due to a more favorable A-factor for three-centered elimination of $:CH_2$. Three-centered elimination of Me_3SiOMe from an sp^2-hybridized carbon to afford a vinylidene is found to be more facile than the analogous elimination from an sp^3-hybridized carbon due both to more favorable energy of activation and A-factor. Thus, silaallene formation from H_2-C(OMe)$SiMe_2SiMe_3$ does not occur due to the greater facility of α-elimination to $H_2C{=}C{:}$.

37123 **Determination of long distance intramolecular triplet energy transfer rates. A quantitative comparison with electron transfer.** Closs, G.L.; Piotrowiak, P.; MacInnis, J.M.; Fleming, G.R. (Univ. of Chicago, IL (USA)). *Journal of the American Chemical Society;* **110**: No. 8, 2652-2653(13 Apr 1988).

Recent efforts in these laboratories have been directed toward understanding the factors governing long distance intramolecular electron transfer (ET). In the models chosen for study the electronic coupling between donor and acceptor is sufficiently weak to assure nonadiabatic reactions. It occurred to them that long distance triplet energy transfer by the Dexter mechanism (TT) of which there are several examples in the literature should exhibit features similar to nonadiabatic electron transfer because both reactions are governed by the same theory of radiationless transitions. They therefore have started a program aimed at finding quantitative similarities and differences in these two processes when studied on directly comparable systems. Also, with one exception, the absolute rates of intramolecular triplet energy transfer have never been measured directly in liquid solution. In this communication they report their first results and conclusions.

37124 **Preparation of rhenium(VII) monoimido alkylidyne complexes and metathesis of acetylenes via rhenacyclobutadiene intermediates.** Schrock, R.R.; Weinstock, I.A.; Horton, A.D.; Liu, A.H.; Schofield, M.H. (Massachusetts Institute of Technology, Cambridge, (USA)). *Journal of the American Chemical Society;* **110**: No. 8, 2686-2687(13 Apr 1988). Contract FG05-86ER75292.

Metathesis of acetylenes by d^0 molybdenum and tungsten alkylidyne complexes of the type $M(CR)(OR')_3$ (R is alkyl, R' is alkyl, fluoroalkyl, or aryl) has been established in the last few years. An interesting question is whether a related rhenium(VII) acetylene metathesis catalyst can be designed, since although acetylene metathesis by rhenium is unknown, rhenium-based catalysts for metathesizing olefins are well-known. They report here several four-coordinate monoimido bisalkoxide neopentylidyne complexes, the metathesis of several internal acetylenes by one of them, and the X-ray structure of a rhenacyclobutadiene complex.

37125 **Tailored organometallics as precursors for the chemical vapor deposition of high-purity palladium and platinum thin films.** Gozum, J.E.; Pollina, D.M.; Jensen, J.A.; Girolami, G.S. (Univ. of Illinois, Urbana (USA)). *Journal of the American Chemical Society;* **110**: No. 8, 2688-2689(13 Apr 1988). Contract AC02-76ER01198.

The fabrication of electronic devices by chemical vapor deposition is a rapidly expanding area of great current interest. Metal-organic chemical vapor deposition (MOCVD) routes to the preparation of semiconductor thin films, such as GaAs from $GaMe_3$ and AsH_3, are becoming increasingly attractive, due largely to the high growth rates, high purity, high crystal quality, and ease of process control that are characteristic of the MOCVD method. However,

despite the intensive study of the synthesis of main-group materials by MOCVD, relatively few studies of the deposition of thin films that contain transition metals have been reported, largely because suitably volatile and reactive molecular CVD precursors are scarce. For example, palladium films are of interest as a potential replacement for gold as an electrical contact material in integrated circuits. This interest arises from its high electrical conductivity, its resistance to oxidation, and its economic advantages over gold. While palladium films have been made by electroplating, vacuum sputtering, and laser direct-write metallization, no CVD methods have been reported to date, despite the advantages offered by this technique. Here they report the synthesis of high-quality Pd and Pt films by MOCVD from tailored organometallic precursors under mild conditions.

37126 **Charge-transfer stabilization of molecular bicimers: ion pair formation in diarylmethanes.** Locke, R.J.; Modiano, S.H.; Lim, E.C. (Wayne State Univ., Detroit, MI (USA)). *Journal of Physical Chemistry;* **92**: No. 7, 1703-1705(7 Apr 1988).

The authors demonstrate here that the bicimer of aromatic hydrocarbons is stabilized largely by charge-transfer interactions. The bicimer is a dimeric species formed by the association of two identical, electronically excited molecules.

37127 **Pressure effects on the intervalence-transfer electronic absorption band of the mixed-valence Creutz-Taube ion in various media.** Hammack, W.S.; Lowery, M.D.; Hendrickson, D.N.; Drickamer, H.G. (Univ. of Illinois, Urbana (USA)). *Journal of Physical Chemistry;* **92**: No. 7, 1771-1774(7 Apr 1988). Contract AC02-76ER01198.

In this paper the authors present the results of a pressure tuning spectroscopy (PTS) study of the intervalence-transfer (IT) band of the (Cl_5 x $5H_2O$) salt of the Creutz-Taube ion. They studied this compound in three media: (1) as a crystalline solid, (2) doped in the polyelectrolyte poly(styrenesulfonic acid) (PSS), and (3) in water (D_2O). In all cases the principal effect of pressure on the IT band was found to be a shift of the band to higher energy. For the microcrystalline sample this shift was $\sim$ 400 cm^{-1} over a pressure range from 0.001 to 200 kbar (1 kbar = 986.9 atm). In this same pressure range the blue shift of the IT band for the PSS-doped sample was $\sim$ 600 cm^{-1}. In water (D_2O) the shift was $\sim$ 35 cm^{-1} in a pressure range from 0.001 to 7 kbar. In addition to the Gaussian fits described above they have fit the spectra using a vibronic coupling model developed by Piepho, Krausz, and Schatz (PKS). When analyzed in terms of this simple small-polaron model, this peak shift corresponds primarily to an increase in the electronic coupling between the metal centers of the ion. The degree of vibronic coupling changes either only slightly or not at all with pressure.

37128 **Photoelectron spectroscopy of sulfur ions.** Moran, S.; Ellison, G.B. (Univ. of Colorado, Boulder (USA)). *Journal of Physical Chemistry;* **92**: No. 7, 1794-1803(7 Apr 1988). Contract AC02-80ER10722.

Photoelectron spectra of a number of sulfur-containing negative ions have been measured, and the following electron affinities are reported: EA(S_2) = 1.670 +/- 0.015 eV, EA(HS_2) = 1.907 +/- 0.023 eV, EA(DS_2) = 1.912 +/- 0.015 eV, EA(CH_3S_2) = 1.757 +/- 0.022 eV, EA(CD_3S_2) = 1.748 +/- 0.022 eV, EA(CH_3CH_2S) = 1.947 +/- 0.013 eV, EA(CH_3SCH_2) = 0.868 +/- 0.051 eV, EA(CH_3S) = 1.871 +/- 0.012 eV, and EA(CH_2S) = 0.465 +/- 0.023 eV. For the first five anions, the photoelectron spectra consist of excitation of the S-S stretching mode of the radical. Wherever possible, the spectroscopic information obtained is used to elucidate geometries and thermochemistry of these reactive intermediates. Results from these sulfur-containing ions and radicals are compared with what is known about their oxygen analogues.

37129 **Visible and near-infrared Ge-H vibrational overtones in GeH_4.** Bernheim, R.A.; Allbee, D.C.; Lampe, F.W.; O'Keefe, J.F.; Qualey, J.R. III. (Pennsylvania State Univ., University Park (USA)). *Journal of Physical Chemistry;* **92**: No. 7, 1850-1852(7 Apr 1988).

Absorption spectra in the 11,000-18,000-cm^{-1} range have been recorded for gaseous GeH_4 by intracavity photoacoustic detection with CW dye lasers. The observed transitions correspond to Δv = 6-9 overtones of the Ge-H local mode stretch and show band contours arising from rotational structure at sample pressures of 1 atm. The local mode Ge-H stretch can be characterized by omega/sub e/ = 2178.3 +- 0.3 cm^{-1} and omega/sub e/chi/sub e/ = 33.7 +- 0.1 cm^{-1}. In addition, the Δv = 5-8 + ν_4 combinations were observed. Evidence for chemical reaction induced by the Δv = 9 excitation is also found.

37130 **Role of metastable atoms in glow discharge ionization processes.** Hess, K.R.; Harrison, W.W. (Univ. of Virginia, Charlottesville (USA)). *Analytical Chemistry;* **60**: No. 7, 691-696(1 Apr 1988).

Ionization processes have been studied in a glow discharge using neon and argon as discharge gases. A tunable laser served to depopulate metastable atom populations, and the effects were followed by optical galvanic spectroscopy and mass spectrometry. In the neon discharge, depopulation of the metastables caused a general reduction in all measured ion signals, while similar studies with argon showed that many species with ionization potentials greater than the metastable energies of argon were not affected by laser depopulation. These results provide evidence for the role of Penning ionization in the glow discharge.

37131 **Synthesis and asymmetric reactivity of enantiomerically pure cyclopentadienylmetal complexes derived from the chiral pool.** Halterman, R.L.; Vollhardt, K.P.C. (Univ. of California, Berkeley (USA)). *Organometallics;* **7**: No. 4, 883-892(Apr 1988).

Starting from pulegone, camphor, and tartrate, three chiral cyclopentadienes were prepared efficiently. Metalation with $Co_2(CO)_8$ and $TiCl_3$ resulted in new chiral and enantiomerically pure substituted cyclopentadienyldicarbonylcobalt and -titanocene complexes. The latter were used in the quantitative catalytic asymmetric hydrogenation of 2-phenyl-1-butene in up to 34% optical yield. The former allowed the first asymmetric [2 + 2 + 2] cycloadditions promoted by chiral cyclopentadienylcobalt complexes to be observed.

37132 **Clusters containing carbene ligands. 3. The transformations of a (dimethylamino)methyl ligand in a triosmium cluster. The synthesis and structural characterizations of $Os_3(CO)_{10}(\mu\text{-eta}^2\text{-}H_2CNMe_2)(\mu\text{-H})$, $Os_3(CO)_9[\mu_3\text{-eta}^2\text{-}C(H)NMe_2](\mu\text{-H})_2$, and $Os_3(CO)_{10}(\mu\text{-}CNMe_2)(\mu\text{-H})$.** Adams, R.D.; Babin, J.E. (Univ. of South Carolina, Columbia (USA)). *Organometallics;* **7**: No. 4, 963-969(Apr 1988).

The authors have recently discovered that bis(dialkylamino)-methane compounds are effective reagents for the introduction of secondary (dialkylamino)carbene ligands into osmium carbonyl clusters. They have now examined the reaction of $Os_3(CO)_{10}(\mu\text{-H})_2$ with $CH_2(NMe)_2$. This reaction yields initially the new compound $Os_3(CO)_{10}(\mu\text{-eta}^2\text{-}H_2CNMe_2)(\mu\text{-H})$ which can be transformed into the compounds $Os_3(CO)_9[\mu_3\text{-eta}^2\text{-}C(H)NMe_2](\mu\text{-H})_2$ and $Os_3(CO)_{10}(\mu\text{-}CNMe_2)(\mu\text{-H})$ through a sequence of C-H activation processes in the (dimethylamino)methyl group. The results of these studies are reported herein.

37133 **Synthesis and characterization of sodium-titanium phosphates, $Na_4(TiO)(PO_4)_2$, $Na(TiO)PO_4$, and $NaTi_2(PO_4)_3$*.** Bamberger, C.E.; Begun, G.E.; Cavin, O.B. (Oak Ridge National Lab., TN (USA)). *Journal of Solid State Chemistry;* **73**: No. 2, 317-324(Apr 1988). Contract AC05-84OR21400.

Experimental examination of part of the system Na_2O-TiO_2-P_2O_5 revealed the existence of two new sodium-titanium phosphates, $Na(TiO)(PO)_4$ and $Na(TiO)P)_4$. Their synthesis was accomplished by several different reactions and their identity was established by means of Raman spectroscopy and X-ray diffraction. Additionally, novel reactions for the synthesis of $NaTi_2(PO_4)_3$ have been demonstrated.

37134 **Synthetic and structural study of the zirconium-antimony system.** Garcia, E.; Corbett, J.D. (Iowa State Univ., Ames (USA)). *Journal of Solid State Chemistry;* **73**: No. 2, 440-451(Apr 1988). Contract W-7405-ENG-82.

Ten phases have been examined in the Zr-Sb system using arc-melting, annealing, powder sintering, vapor-phase transport, vaporization, and metal flux methods. In addition to the previous reported compositions (and structure types) Zr_3Sb (Ni_3P), Zr_5Sb_3 (Mn_5Si_3), and $ZrSb_2$), there also exist $Zr_2Sb(La_2Sb)$, high temperature Zr_5Sb_3 (Y_5Bi_3), ZrSb/sub 1-x/ (FeSi), ZrSb (ZrSb-Cmcm), and low temperature ZrSb/sub 2-x/ ($PbCl_2$). There are also phases of unknown structure near the Zr_2Sb composition at high temperatures and for Zr_2Sb_3 that are provisionally primitive orthorhombic and tetragonal, respectively. The Mn_5Si_3-type phase Zr_5Sb/sub 3+x/ is a true binary and nonstoichiometric over the ranges $0.0 \leqq x$ 0.4. Guinier lattice constant data are reported for all the phases.

37135 **Study of the crystal structures of ZrSb and β-$ZrSb_2$ and of the bonding in the two $ZrSb_2$ structures.** Garcia, E.; Corbett, J.D. (Iowa State Univ., Ames (USA)). *Journal of Solid State Chemistry;* **73**: No. 2, 452-467(Apr 1988). Contract W-7405-ENG-82.

The structures of ZrSb and β-$ZrSb_2$ have proven to be orthorhombic with, respectively, a = 3.827(1), 7.393(1) A, b = 10.426(3), 3.9780(7) A, c = 14.007(5), 9.581(1) A; space group Cmcm, Pmma; Z = 12, 4; R = 0.037, 0.032; R/sub w/ = 0.045, 0.039, for 327 and 345 independent reflections with $2\theta \leqq 55°$. The new ZrSb structure can be described in terms of sheets of interlinked cofacial trigonal prismatic chains of zirconium centered by antimony that are separated by layers of weakly bonded antimony resembling those in the element. The substoichiometric β-form of $ZrSb_2$ (ZrSb/sub 1.96) has a $PbCl_2$-type structure and contains zigzag chains of antimony atoms [d(Sb-Sb) = 2.89 A] more weakly bonded to other antimony atoms to form ribbons. Some of the same features occur in the previously known α-$ZrSb_2$ modification. The electronic interactions of the two $ZrSb_2$ structures are compared with the aid of extended-Hueckel density-of-states calculations. The heteroatomic bonding is dominant, with stronger Sb-Sb bonding in results in β-$ZrSb_2$. Significant Zr-Sb covalence, interantimony bonding, and the broad Zr-Sb valence band that results in β-$ZrSb_2$. Significant Zr-Sb covalence, interantimony bonding, and the broad Zr-Sb valence band that results in β-$ZrSb_2$ remove it from the class of simple Zintl phases. Both compounds are predicted to be metallic, and α-$ZrSb_2$ is confirmed to exhibit metallic behavior ($rho/_{298} \approx 1.2 \times 10^{-4}$ ohm cm).

37136 **Low energy consumption method for separating gaseous mixtures and in particular for medium purity oxygen production.** Jujasz, A.J.; Burkhart, J.A.; Greenberg, R. (to Dept. of Energy, Washington, DC). US Patent 4,732,597. 22 Mar 1988. Filed date 22 Apr 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for the separation of gaseous mixtures, the major components of which are oxygen and nitrogen, for producing medium purity oxygen is described comprising: compressing the gaseous mixture in a first compressor to super atmospheric pressure, and dividing the pressurized gaseous mixture into first and second mixture streams; cooling the first mixture stream to its boiling point and introducing the first mixture stream into the high pressure chamber of a double rectification column; compressing and cooling the second mixture stream, condensing the cooled second mixture stream, and delivering the condensed second mixture stream to the high pressure chamber of the double rectification column; separating the gaseous mixtures in the double rectification column into a liquid oxygen product stream and a gaseous nitrogen stream, removing the liquid oxygen product stream from the low pressure chamber of the double rectification column, pumping the liquid oxygen product stream to a predetermined pressure, evaporating the oxygen product stream in an evaporator-condenser, heating the oxygen product stream, and blending the oxygen product stream with a compressed blend-air stream to the desired oxygen concentration.

37137 **Intrazeolite chemistry of nickel(0) complexes and Ni(0,II) clusters studied by EXAFS, solid state NMR, and FR-IR spectroscopy.** Bein, T.; McLain, S.J.; Corbin, D.R.; Farlee, R.D.; Moller, K.; Stucky, G.D.; Woolery, G.; Sayers, D. (E.I. du Pont de Nemours and Company, Wilmington, DE (USA)). *Journal of the American Chemical Society;* **110**: No. 6, 1801-1810(16 Mar 1988). Contract AS05-80ER10742.

Adsorption, thermal decomposition, and reactivity of $NI(CO)_4$ in the cage system of dehydrated zeolite Y has been studied with EXAFS and near-edge spectroscopies, in particular monitoring changes in oxidation states and Ni ligation. $Ni(CO)_4$ is adsorbed as an intact molecule in cation-free zeolite Y, LiY, and NaY. Symmetry changes of the molecule in LiY and NaY are assigned to the formation of cation--OC-Ni bridges. Thermal treatment of the $Ni(CO)_4$NaY adduct leads to loss of CO concomitant with the formation of a bimodal Ni phase. A major part of the Ni forms small clusters (approximately 0.5 to 1.5 nm), in addition to larger crystallites (5-30 nm), sticking at the outer surface of the zeolite crystals. Oxidation of $Ni(CO)_4$NaY to NiONaY with molecular oxygen occurs almost to completion below 295 K. The small NiO particles are stable to sintering up to 670 K. Nickel-phosphineNaY adducts have been prepared by direct adsorption from solution [$Ni(CO)_3PMe_3$, $Ni(CO)_2(PMe_3)_2$], and by synthesis inside the NaY supercage [$Ni(CO)_3PMe_3$, $Ni(CO)_3(PPh_2CHMe_2)$, $Ni(CO)_3P(tau\text{-}Bu)_3$, $Ni(PMe_3)$/sub x/]. The $NaYNi(CO)_3(PPh_2CHMe_2)$ adduct is a ship-in-a bottle complex, i.e., the Ni complex is too large to exit the zeolite supercage. The substitution of carbonyl ligands by phosphines was monitored in the near-edge and EXAFS modulations as well as with ^{31}P MAS NMR. EXAFS is an excellent method to monitor ligand coordination and provides information that is complimentary to IR spectroscopy.

37138 **Synthesis and structure of the polymetallic yttrium alkoxide complex $Y_3(\mu_3\text{-}OCMe_3)(\mu_3\text{-}Cl)(\mu\text{-}OCMe_3)_3(OCMe_3)_4(THF)_2$ and related complexes: $Ln_3(\mu_3\text{-}OR)(\mu_3\text{-}X)(\mu_3\text{-}OR)_3$ building blocks in yttrium and lanthanide alkoxide chemistry.** Evans, W.J.; Sollberger, M.S.; Hanusa, T.P. (Univ. of California, Irvine (USA)). *Journal of the American Chemical Society;* **110**: No. 6, 1841-1850(16 Mar 1988).

Since factors are so important in the chemistry of yttrium and the lanthanide elements, the authors felt it was essential to obtain more structural data on the alkoxide complexes they would use as starting materials for C_5R_5 free organoyttrium and organolanthanide systems. In this report they describe the synthesis as structural features of yttrium and lanthanum alkoxide complexes which represent prototypical starting materials for synthesis of organoyttrium and organolanthanide alkoxide alkyl and hydride complexes. They have chosen Y and La because these metals are representative of late and early lanthanide chemistry, respectively, and provide diamagnetic compounds characterizable by NMR spectroscopy. To keep the spectroscopy as simple as possible they have worked exclusively with the tert-butoxide ligand which gives soluble complexes with a single ^1H NMR resonance per ligand.

37139 **Radical cation cyclization of 1,5-hexadiene to cyclohexene via the cyclohexane-2,5-diyl radical cation intermediate.** Guo, Q.X.; Qin, X.Z.; Wang, J.T.; Williams, F. (Univ. of Tennessee, Knoxville (USA)). *Journal of the American Chemical Society;* **110**: No. 6, 1974-1976(16 Mar 1988).

The classical example of a neutral carbon-centered radical cyclization reaction is the regioselective 1,5-ring closure (exocyclization) of the 5-hexenyl radical to the cyclopentylcarbinyl radical. Here the authors report the title reaction, a comparable addition process whereby an α, omega-diene radical cation reacts by endocyclization and hydrogen shift(s) to produce a cycloolefin radical cation.

37140 **Solid-surface luminescence interactions of nitrogen heterocycles adsorbed on silica gel chromatoplates submerged in chloroform/n-hexane solvents.** Burrell, G.J.; Hurtubise, R.J. (Univ. of Wyoming, Laramie (USA)). *Analytical Chemistry;* **60**: No. 6, 564-568(15 Mar 1988). Contract FG02-86ER13547.

The room-temperature fluorescence (RTF) and room-temperature phosphorescence (RTP) of benzo[f]quinoline and benzo[h]quinoline, obtained from the samples adsorbed on silica gel chromatoplates submerged in chloroform/n-hexane solvents, revealed several of the interactions of the nitrogen heterocycles with the solid matrix. The RTP results showed the emitting phosphor was protected from collisional deactivation by the matrix and that the adsorbed chloroform minimally disrupted the phosphor adsorp-

tion interactions. In addition, at least two populations of phosphors were indicated. The RTF data and RTP data showed that different interactions were occurring in the singlet state compared to the triplet state. A comparison of RTF intensity and TRP intensity as a function of chromatographic solvent strength indicated that the protonated forms of the nitrogen heterocycles in their triplet states were interacting with the matrix more strongly than the protonated forms of the nitrogen heterocycles in their singlet states.

37141 **Energy-transfer reactions of $N_2(A^3\Sigma/sub\ u/^+)$ to SO and other diatomic and polyatomic molecules.** Cao, D.Z.; Setser, D.W. (Kansas State Univ., Manhattan (USA)). *Journal of Physical Chemistry;* **92**: No. 5, 1169-1178(10 Mar 1988). Contract W-7405-ENG-48.

The total quenching rate constant of $N_2(A^3\Sigma/sub\ u/^+)$ by SO and the formation rate constant of $SO(A^3II)$ have been measured in a flow reactor by using microwave discharges of dilute $SOCl_2$Ar mixtures as sources of SO(X). The initial vibrational distribution of SO(A) was estimated by extrapolating the steady-state distributions to low pressure. Other excitation-transfer reactions of N_2(A) are summarized and compared with the SO and S_2 reactions. Total quenching rate constants of $N_2(A^3\Sigma/sub\ u/^+)$ also were measured for several diatomic halogens and for PF_3, PCl_3, $POCl_3$, NF_3, SOF_2, SO_2F_2, CCl_2F_2, CF_4, and HN_3. In several instances, effective N_2(A) decay constants also were measured for dilute mixtures of these reagents that had been passed through a microwave discharge. Unsuccessful attempts to excite $PF(A^3II)$, $PCl(A^3II)$, $PO(B^2\Sigma^+)$, and CF_2(anti $A,^1A_1$) from reaction of N_2(A) with the products from the microwave discharges in PF_3, PCl_3, $POCl_3$, and CF_2Cl_2 (and CF_4) are summarized. The rate constants for formation of $I_2(D')$ from I_2 and NH(A) from HN_3 are small. Qualitative experiments demonstrated that the N_2(A) + XeF_2 reaction does not have a significant branching fraction for XeF(B) formation.

37142 **Intramolecular coupling of eta²-iminoacyl groups at group 4 metal centers: a kinetic study of the carbon-carbon double-bond-forming reaction.** Durfee, L.D.; McMullen, A.K.; Rothwell, I.P. (Purdue Univ., West Lafayette, IN (USA)). *Journal of the American Chemical Society;* **110**: No. 5, 1463-1467(2 Mar 1988). Contract FG22-85PC80909.

The series of bis(eta²-iminoacyl) compounds of general formula $M(OAr)_2(eta^2\text{-}R'NCR)_2$ (M = Ti, Zr, Hf; OAr = 2,6-diisopropyl- and 2,6-di-tert-butylphenoxide; R = CH_3, CH_2Ph; R' = various substituted phenyls) undergo intramolecular coupling on thermolysis to produce the corresponding enediamide derivatives $M(OAr)_2[R'NC(R) = C(R)NR']$. A kinetic study of the reaction in hydrocarbon solvents has shown it to be first order. The reaction is metal dependent with the rate decreasing in the order Ti > Zr > Hf. The rate of the reaction is also dependent on the steric and electronic nature of the nitrogen substituent (R'). The use of the bulky aryl group 2,6-dimethylphenyl retards the reaction, while the use of various 3- and 4-substituted phenyls (3-F, 3-OMe, 4-OMe, 4-Cl, 4-NMe_2) shows the reaction to be accelerated by electron-withdrawing substituents. A σ plot based on kinetic data obtained at 67°C and 77°C yielded rho values of 0.83 (R = 0.97) and 0.84 (R = 0.95), respectively. Both the steric and electronic dependence of the reactivity on the nitrogen substituents is discussed mechanistically and used to rationalize the much more facile intramolecular coupling observed for the related eta²-acyl (eta²-OCR) functionalities.

37143 **Encapsulation of the transition metals chromium through cobalt in zirconium cluster iodides.** Hughbanks, T.; Rosenthal, G.; Corbett, J.D. (Iowa State Univ., Ames (USA)). *Journal of the American Chemical Society;* **110**: No. 5, 1511-1516(2 Mar 1988).

The phases $Zr_6I_{12}Cr$, $Zr_6I_{12}Mn$, $Zr_6I_{14}Fe$, $Zr_6I_{14}Co$, $CsZr_6I_{14}Mn$, Cs/sub 0.63/$Zr_6I_{14}Fe$, and Cs/sub x/$Zr_6I_{14}Co$ have been synthesized by reaction of Zr, ZrI_4, the appropriate transition-metal diiodide, and cesium iodide where appropriate at 750-850°C in sealed tantalum containers. They have the structural frameworks of $Zr_6I_{12}C$ (space group R anti 3) or $CsZr_6I_{14}C$ (Cmcs) but with the transition metal interstitial instead of carbon centered in the expanded zirconium octahedra. The structures of $CsZr_6I_{14}Mn$ and Cs/sub 0.63/$Zr_6I_{14}Fe$ were established by single-crystal X-ray diffraction methods. The zirconium-interstitial distances in the relatively large clusters are short compared with other examples, averaging 2.490 and 2.484 A, respectively. Extended Hueckel calculations for $Zr_6I_{14}Fe$ highlight the differences between transition-metal and main-group interstitial elements, the former exhibiting a preferred stability at 18 rather than 14 cluster-binding electrons through the addition of the nonbonding e/sub g/⁴ level on the interstitial. The iron-zirconium bonding in the cluster is notably greater than that in Zr_6Fe. The phase $CsZr_6I_{14}Mn$ is properly diamagnetic, while the magnetic susceptibility data for the 19-electron $Zr_6I_{12}Mn$ are well described by a high-temperature μ/sub eff/ of 1.84 μ/sub B/ and an intracluster spin-orbit coupling (zeta = 312 cm^{-1}) that partially quenches the moment at lower temperatures.

37144 **Difference in the methyl group conformational preferences of T_1 and S_1 acetophenone. A probe of the orbital character of excited electronic states.** Tomer, J.L.; Spangler, L.H.; Pratt, D.W. (Univ. of Pittsburgh, PA (USA)). *Journal of the American Chemical Society;* **110**: No. 5, 1615-1617(2 Mar 1988).

Ethane exists, in its electronic ground state, primarily in the staggered form because of the mutual repulsion between the filled π/sub CH_3/ orbitals of the two methyl groups in the higher energy eclipsed form. The same considerations dictate the more stable conformation of a methyl rotor attached to an R(-C) = X group, as in propene (R = H, X = CH_2), acetaldehyde (R = H, X = O), and acetophenone (R = phi, X = 0), all of which have a C-H bond eclipsed rather than staggered with the double bond in the ground state (S_0). But, because of the sensitivity of these nonbonding interactions to the orbital occupancies of neighboring groups, the situation might be expected to be different in electronically excited states. A realization of this expectation is reported. A difference exists in the conformational preferences of the methyl group in the lowest excited triplet (T_1) and singlet (S_1) states of acetophenone, probably because of a difference in their orbital characters. The dynamic implications of this result are discussed.

37145 **Resonance Raman spectroscopic investigation of axial coordination in M. thermoautotrophicum methyl reductase and its nickel tetrapyrrole cofactor F_{430}.** Shiemke, A.K.; Scott, R.A.; Shelnutt, J.A. (Univ. of Georgia, Athens (USA)). *Journal of the American Chemical Society;* **110**: No. 5, 1645-1646(2 Mar 1988). Contract AC04-76DP00789.

The S-methyl coenzyme M [CH_3-S-CoM, 2-(methylthio)ethanesulfonic acid] methylreductase enzyme of Methanobacterium thermoautotrophicum contains F_{430}, the nickel-tetrapyrrole cofactor which is thought to be the site of reduction of CH_3-S-CoM to methane and HS-CoM. Here the use of resonance Raman spectroscopy is reported for the investigation of the well-characterized forms of isolated F_{430} in aqueous solution and the intact methylreductase. The Raman spectra were obtained on pairs of 100-200 μM samples by using a split cell designed for a Raman difference spectrometer described previously. The spectra were excited at 441.6 nm with a 40 mW defocused, unpolarized beam of a helium-cadmium laser (Omnichrome) operating at 4-cm^{-1} resolution.

37146 **Intermediacy of paramagnetic metal-hydrocarbyl species in organometallic reactions. Detection and characterization of a novel paramagnetic iron(II)-benzyl compound in the coupling of benzyl halides.** Hill, D.H.; Sen, A. (Pennsylvania State Univ., University Park (USA)). *Journal of the American Chemical Society;* **110**: No. 5, 1650-1652(2 Mar 1988). Contract FG02-84ER13295.

Paramagnetic metal-hydrocarbyl species have been postulated as intermediates in several organometallic reaction sequences. In the preponderance of these reactions the paramagnetic intermediate has been detected by ESR spectroscopy. In other cases these species have been implicated by the observation of CIDNP as a result of the formation of an accompanying organic radical. Unfortunately, the more direct characterization of these intermediates by NMR spectroscopy based upon chemical shifts and resonance intensities has, thus far, been hindered by sever line broadening. Herein, the authors report the detection and characterization by NMR spectroscopy of a novel paramagnetic Fe(II)-benzyl compound $(TMEDA)Fe(CH_2Ph)_2$, which is the key intermediate in the cou-

pling of benzyl halides by [CpFe(COD)][Li-(TMEDA)], (Cp = $C_5H_5^-$, COD = 1,5-cyclooctadiene, TMEDA = $Me_2N(CH_2)_2NMe_2$).

37147 **Tantalum(I) alkyne complexes: $Ta(CO)_2(eta^2-RC{=}CR)(I)L_3$.** McGeary, M.J.; Gamble, A.S.; Templeton, J.L. (Univ. of North Carolina, Chapel Hill (USA)). *Organometallics;* 7: No. 2, 271-279(Feb 1988).

Excess alkyne reacts with $Ta(CO)_3(I)L_2$ to form $Ta(CO)_2(eta^2-RC{=}CR)(I)L_2$ complexes (L = PMe_3 and RCCR = PhCCPh (3), PhCCH (4), HCCH (5), $Ph_2PCCPPh_2$ (6); L = $P(OMe)_3$ and RCCR = PhCCPh (7)). These octahedral d^4 tantalum alkyne adducts have been characterized by ^1H, ^{13}C, and ^{31}P NMR, as well as by infrared and visible spectroscopy. Low-field acetylenic proton and carbon resonances are compatible with a four-electron donor alkyne description for these complexes. Variable-temperature ^{13}C NMR studies of ^{13}CO enriched $Ta(CO)_2(PhCCH)(I)(PMe_3)_2$ revealed a ΔGdouble dager of 16 kcal/mol for alkyne rotation about the C-C midpoint of the tantalum-alkyne axis. The X-ray crystal structure of $Ta(CO)_2(PhCCPh)(I)(PMe_3)_2$ has been determined. [Crystal data: monoclinic, $P2_1/c$; a = 12.304 (4) A, b = 30.971 (8) A, c = 13.967 (5) A; β = 96.91 (3)°; Z = 8.] The molecule adopts a distorted octahedral geometry with trans carbonyl ligands and trans PMe_3 ligands. The alkyne is trans to iodide to complete the coordination sphere, and the C-C axis is parallel to the OC-Ta-CO axis. Average metal-ligand bond distances for the two independent molecules in the unit cell are Ta-I, 2.88 (1) A; Ta-C (alkyne), 2.06 (6) A; and Ta-CO, 1.98 (9) A. There is a definite pyramidal distortion of the four equatorial ligands away from the alkyne ligand toward the trans iodide.

37148 **Comparison of the electronic structure of disubstituted ferrocenes.** Dowben, P.A.; Driscoll, D.C.; Tate, R.S.; Boag, N.M. (Syracuse Univ., NY (USA)). *Organometallics;* 7: No. 2, 305-308(Feb 1988). Contract FG02-87ER45319;W-7405-ENG-82.

The authors have measured the optical absorption of gaseous ferrocene, 1,1'-dimethylferrocene, 1,1'-dibromoferrocene, and 1,1'-dichloroferrocene using synchrotron radiation. From these data they have estimated the ligand field parameters and noted increasing e/sub 2g/(d) to Cp(π) overlap with increasing charge transfer from the Cp ring to the substitution.

37149 **Reaction of organoboranes with olefinic α,β-unsaturated nitro compounds.** Kabalka, G.W.; Gai, Y.Z.; Goudgaon, N.M.; Varma, R.S.; Gooch, E.E. (Univ. of Tennessee, Knoxville (USA)). *Organometallics;* 7: No. 2, 493-495(Feb 1988). Contract FG05-86ER60434.

The reaction of lithium triethylborohydride with nitroalkenes in the presence of borane results in the unexpected formation of N-ethylamine derivatives. Evidence supports a reaction sequence involving the 1,2-addition of triethylborane to a nitroso intermediate.

37150 **Dimethylsilanone ($Me_2Si{=}O$) generation by retroene decomposition of allyloxysilanes.** Barton, T.J.; Bain, S. (Iowa State Univ., Ames (USA)). *Organometallics;* 7: No. 2, 528-531(Feb 1988).

Gas-phase thermolysis of (allyloxy)dimethylsilane cleanly affords dimethylsilanone by retroene decomposition (log A = 12.6, E/sub a/ = 54.6 kcalmol). However, substituting the ether-linked carbon with two methyl groups (3-(dimethylsiloxy)-3-methyl-1-butene) introduces a competition between C-O bond homolysis and retroene decomposition.

37151 **Band electronic structure study of the semimetallic properties and the anisotropic resistivity hump in $ZrTe_3$.** Canadell, E.; Mathey, Y.; Whangbo, M.H. (Universite de Paris-Sud, Orsay (France)). *Journal of the American Chemical Society;* 110: No. 1, 104-108(6 Jan 1988). Contract FG05-86ER45259.

Tight-banding calculations were carried out on $ZrTe_3$ to examine its semimetallic properties and anisotropic resistivity hump at ~ 63K. The authors calculations show that adoption of the type B structure is crucial for the semimetallic nature of $ZrTe_3$. The overlapping of the Te 5p-block bands with the Zr 4d-block bands gives rise to a pair of nested electron pockets and a pair of nested hole pockets, all of which have the shape of a flat cylinder whose axis is perpendicular to the chain direction. Thus, a charge density wave formation associated with the Fermi surface nesting does not affect the electrical conductivity of $ZrTe_3$ along the chain direction, so that the resistivity hump is observed only along the directions perpendicular to the chain axis.

37152 **Calculation of the thermodynamic and transport properties of aqueous species at high pressures and temperatures: dissociation constants for supercritical alkali metal halides at temperatures from 400 to 800°C and pressures from 500 to 4000 bar.** Oelkers, E.H.; Helgeson, H.C. (Univ. of California, Berkeley (USA)). *Journal of Physical Chemistry;* 92: No. 6, 1631-1639(1988). Contract AS03-83ER13100;FG03-85ER13419.

Dissociation constants from 400 to 800°C at 500-4000 bar have been calculated for 14 aqueous alkali metal halides from experimental conductance measurements reported by Quist and Marshall using the Shedlovsky equation and the law of mass action, together with independently calculated limiting equivalent conductances for the electrolytes generated from equations given by Oelkers and Helgeson. The requisite activity coefficients were calculated for neutral and charged species from the Setchenow and extended Debye-Hueckel equations, respectively. Where direct comparison can be made, dissociation constants reported by Quist and Marshall and Dunn and Marshall fall within estimated uncertainties of corresponding values generated in the present study. The logarithms of the calculated dissociation constants range from ~ -0.7 at low temperatures and high pressures to ~ -4.5 at high temperatures and low pressures.

37153 **Double-quantum filter for rotating solids.** Meier, B.H.; Earl, W.L. (Los Alamos National Lab., NM (USA)). *Journal of the American Chemical Society;* 109: No. 26, 7937-7942(23 Dec 1987).

A pulse sequence is demonstrated which effectively excites double-quantum coherences in solid samples rotating at the magic angle. A double-quantum filter using this sequence is presented and applied to ^{13}C-labeled zinc acetate to demonstrate its effectiveness. The ^{13}C-^{13}C scalar coupling between the methyl and carboxyl resonances was observed as well as a shift of 31 Hz in the center of both resonances arising from the homonuclear dipole Hamiltonian. It was also noted that when the spinning sideband patterns of the two coupled resonances overlap, carbon flip-flop transitions are facilitated, resulting in significant broadening of the spectral lines.

37154 **Effects of ion aggregation on the intervalence transfer band of the mixed-valence biferrocenium cation in solution.** Lowery, M.D.; Hammack, W.S.; Drickamer, H.G.; Hendrickson, D.N. (Univ. of Illinois, Urbana (USA)). *Journal of the American Chemical Society;* 109: No. 26, 8019-8024(23 Dec 1987). Contract AC02-76ER01198.

The concentration dependence of the energy (E/sup op/) of the intervalence transfer (IT) electronic absorption band of mixed-valence biferrocenium triiodide dissolved in either nitrobenzene or dichloromethane is examined. In nitrobenzene, E/sup op/ increases rapidly from ~ 5.57 to ~ 6.05 x 10^3 cm^{-1} in the 0.24-0.4 mM range, whereupon further increases in the concentration of biferrocenium triiodide lead to E/sup op/ increasing more gradually to a value ~ 6.3 x 10^3 cm^{-1} at 24 mM. On the other hand, the full width at half maximum (Δ anti $v_1 2$) and the transition moment of the IT band decrease with increasing concentration for biferrocenium triiodide in nitrobenzene. E/sup op/ increases, Δ anti $v_1 2$ remains constant, and the transition moment of the IT band increases with increasing concentration for biferrocenium triiodide in dichloromethane in the more limited range of 0.30-0.95 mM. These concentration dependencies of the IT band for biferrocenium triiodide are attributable to variable degrees of ion aggregation in solution. The concentration dependencies of the electrical conductivity of solutions of biferrocenium triiodide in either nitrobenzene or dichloromethane substantiate this proposal. IT band contours obtained at different concentrations are fit to the PKS vibronic model to

yield parameters that characterize the electronic and vibronic coupling within the mixed-valence biferrocenium cation.

37155 **Selective catalytic dehydrogenation of alkanes to alkenes.** Burk, M.J.; Crabtree, R.H. (Yale Univ., New Haven, CT (USA)). *Journal of the American Chemical Society;* **109**: No. 26, 8025-8032(23 Dec 1987).

Linear and cyclic alkanes can be selectively dehydrogenated to the corresponding alkenes both thermally and photochemically (254 nm) with iridium complexes as catalysts. In the photochemical case, a sacrificial hydrogen acceptor is not required and H_2 is evolved directly. Preferential initial formation of the least stable alkene (e.g., methylenecyclohexane from methylcyclohexane) is explained by attack at unhindered C-H bonds by an oxidative addition to the metal. A subsequent β-elimination gives the alkene. A key feature of the catalyst, $[IrH_2(eta^3\text{-}O_2CCF_3)(PR_3)_2]$ (4), is that the chelating acetate group can open up to allow β-elimination to take place in the alkyl hydride intermediate $[IrH(R)(eta^2\text{-}O_2CCF_3)(PR_3)_2]$. Prolonged reaction times lead to progressive isomerization of the alkene to give the thermodynamic product (e.g., 1-methylcyclohexene from methylcyclohexane). Up to 32 turnovers of dehydrogenation are seen. Deactivation of the catalyst takes place by P-C hydrogenolysis of the PAr_3 ligand in the thermal case; the rise in the amount of ArH formed parallels the fall-off in activity of the catalyst. P-C cleavage does not take place in the photochemical system (R = cyclohexyl).

37156 **Proton transfer from metal hydrides to metal alkynyl complexes. Remarkable carbon basicity of $(C_5H_5)(PMe_3)_2Ru\text{--}C{\equiv}C\text{-}CMe_3$.** Bullock, R.M. (Brookhaven National Lab., Upton, NY (USA)). *Journal of the American Chemical Society;* **109**: No. 26, 8087-8089(23 Dec 1987). Contract AC02-76CH00016.

The reactions of transition-metal hydrides with metal alkynyl compounds are virtually unexplored. The only previous systematic study is Lukehart's synthesis of bridging vinylidene complexes from formal addition of a Pt-H bond across the carbon-carbon triple bond of several metal alkynyl compounds. Davison and Selegue have shown that unsaturated carbon ligands bonded to late transition metals generally undergo β-attack by electrophiles and α-attack by nucleophiles. This suggested that metal vinylidene complexes might be formed by proton transfer from metal hydrides to metal alkynyl complexes. This communication reports the first kinetic and thermodynamic measurements on this type of reaction and provides evidence that certain ruthenium alkynyl complexes are remarkably strong carbon-centered bases.

37157 **Divalent titanium chemistry. Synthesis, reactivity, and x-ray and neutron diffraction studies of $Ti(BH_4)_2(dmpe)_2$ and $Ti(CH_3)_2(dmpe)_2$.** Jensen, J.A.; Wilson, S.R.; Schultz, A.J.; Girolami, G.S. (Univ. of Illinois, Urbana (USA)). *Journal of the American Chemical Society;* **109**: No. 26, 8094-8096(23 Dec 1987). Contract W-31-109-ENG-38.

Low valent organotitanium complexes have been implicated as Ziegler-Natta olefin polymerization catalysts and as stoichiometric reagents in organic synthesis. However, very few low-valent alkyls of titanium have been reported, and, in particular, the divalent oxidation state of titanium is virtually unexplored. The authors now report the synthesis and characterization of the unusual divalent tetrahydroborate complex $Ti(BH_4)_2(dmpe)_2$, 1, and its conversion to the methyl compound $Ti(CH_3)_2(dmpe)_2$, 2. Complex 2 is unique among octahedral complexes of the 3d metals in being low-spin within the t/sub 2g/ manifold and exhibits very unusual NMR features for the titanium methyl group.

37158 **Insertion of carbon monoxide into transition-metal-acyl bonds to form α-ketoacyl complexes.** Sheridan, J.B.; Han, S.; Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA)). *Journal of the American Chemical Society;* **109**: No. 26, 8097-8098(23 Dec 1987).

Migratory insertion of CO into transition-metal-alkyl bonds to form acyl ligands is one of the most studied of all transition-metal organometallic reactions. In contrast, the insertion of a second CO into a metal-acyl bond to form an α-ketoacyl ligand has never been observed, even though a number of important double carbonylation reactions could involve such a transformation. However, the only mechanistically studied double carbonylation catalyst has been shown to form α-ketoamide products not by CO insertion into a metal-acyl bond but by reductive-coupling of two acyl ligands. Indeed, all previous studies have led to the general conclusion that insertion of CO into a metal-acyl bond is not a likely reaction. They have now discovered methodology that allows this chemistry to be accomplished by a novel oxidation/NO addition reaction sequence. Reported herein are the first examples of the formal insertion of CO into metal-acyl bonds to form α-ketoacyl ligands.

37159 **H_3O^+ cation in aromatic solvent. Synthesis, structure, and solution behavior of $[H_3O^+ \times 18\text{-crown-}6][Cl\text{-}H\text{-}Cl]$.** Atwood, J.L.; Bott, S.G.; Coleman, A.W.; Robinson, K.D.; Whetstone, S.B.; Means, C.M. (Univ. of Alabama, Tuscaloosa (USA)). *Journal of the American Chemical Society;* **109**: No. 26, 8100-8101(23 Dec 1987).

The interaction of the oxonium ion, H_3O^+, with polar solvents has been extensively reviewed in the broader context of hydrogen bonding. The first report of a complex of H_3O^+ and a macrocycle was an infrared spectroscopic study in 1972. More recently several reports have appeared. This has proved to be a method of isolation of H_3O^+ from higher hydrated species, H_3O^+ coordinated to macrocycles have been reported, one which lends strong support for pyramidal H_3O^+, and one which may be interpreted in terms of planar H_3O^+. In the extensive literature of the oxonium ion, evidence for the species in aromatic solution has not bee presented. Here the authors report that the oxonium ion coordinated to 18-crown-6 does indeed have a stable existence in aromatic media.

37160 **Carbon-hydrogen bond activation by electrophilic transition-metal compounds. Palladium(II)-mediated oxidation of arenes and alkanes including methane.** Gretz, E.; Oliver, T.F.; Sen, A. (Pennsylvania State Univ., University Park (USA)). *Journal of the American Chemical Society;* **109**: No. 26, 8109-8111(23 Dec 1987). Contract FG02-84ER13295.

The activation of carbon-hydrogen bonds by transition metals that leads to the selective functionalization of hydrocarbons, especially alkanes, is one of the most challenging problems in organometallic chemistry. Herein, the authors report on the palladium(II)-mediated oxidation of arenes and alkanes through a nonradical, electrophilic C-H activation pathway.

37161 **Molecular hydrogen complexes. 5. Electronic control of $eta^2\text{-}H_2$ versus dihydride coordination. Dihydride structure of $MoH_2(CO)(R_2PC_2H_4PR_2)_2$ for R = Et, i-Bu versus $eta^2\text{-}H_2$ for R = Ph.** Kubas, G.J.; Ryan, R.R.; Unkefer, C.J. (Los Alamos National Lab., NM (USA)). *Journal of the American Chemical Society;* **109**: No. 26, 8113-8115(23 Dec 1987).

Since their discovery, new examples of transition-metal molecular-hydrogen (M-$eta^2\text{-}H_2$) complexes have been established at an increasingly rapid pace, including several complexes previously formulated as classical hydrides (e.g., $FeH_4(PEtPh_2)_3$). Equilibrium between dihydrogen and dihydride ligands has been observed in solution, /sup 2a,2d/ emphasizing that $eta^2\text{-}H_2$ complexes can be considered tautomers of hydrides and not merely arrested intermediates in hydride formation. Much remains to be learned about these complexes which represent the first examples of coordination of a σ bond to a metal. In particular, the electronic (e.g., ligand basicity) and steric (ligand bulk) factors which stabilize H_2 binding are not yet completely understood. The authors report here the preparation of a series of complexes in which the fate of hydrogen addition ($eta^2\text{-}H_2$ versus dihydride binding) rests primarily upon the basicity of the metal center as dictated by the electron-donating ability of ancillary phosphine ligands.

37162 Crystal structures of $[Au(DDDT)_2]^0$ and $[(n\text{-}Bu)_4N][Ni(DDDT)_2]$ and the ligandlike character of the isoelectronic radicals $[Au(DDDT)_2]^0$ and $[Ni(DDDT)_2]^-$. Schultz, A.J.; Wang, H.H.; Soderholm, L.C.; Sifter, T.L.; Williams, J.M.; Bechgaard, K.; Whangbo, M.H. (Argonne National Lab., IL (USA)). *Inorganic Chemistry;* **26**: No. 22, 3757-3761(4 Nov 1987). Contract W-31-109-ENG-38;FG05-86ER45259.

Use of the dithiolene ligand 5,6-dihydro-1,4-dithiin-2,3-dithiolate (DDDT) led to the new gold complex $[Au(DDDT)_2]^0$. A single-crystal x-ray diffraction study shows that the crystal of $[Au(DDDT)_2]^0$ molecules packs in a dimerlike motif as found for the crystal of neutral bis(ethylenedithio)-tetrathiafulvalene (ET) molecules. In terms of valence electrons, $[Au(DDDT)_2]^0$ and $[Ni(DDDT)_2]^-$ molecules are isoelectronic. The present molecular orbital calculations suggest that the metal ions of both molecules are best described as d^8 ions as expected for square-planar metal complexes, and so an unpaired electron in each molecule resides largely on the DDDT ligands with a small delocalization into the metal ion. The crystal of $[Au(DDDT)_2]^0$ molecules shows no ESR absorption, which is likely due to the dimerlike packing motif and can be regarded as a consequence of a strong spin-Peierls distortion. The synthesis, single-crystal x-ray structure, and magnetic susceptibility of $[(n\text{-}Bu)_4N][Ni(DDDT)_2]$ are also reported. In this salt, $[Ni(DDDT)_2]^-$ molecules are found to form stacks, in contrast to those in $[Et_4N][Ni(DDDT)_2]$, which form layers. Unit cell parameters for $[Au(DDDT)_2]^0$ are space group $P2_1/n$, a = 6.496 (1) A, b = 13.267 (4) A, c = 16.775 (3) A, β = 94.87 (2)°, V = 1440.5 (5) A^3, and Z = 4. For $[(n\text{-}Bu)_4N][Ni(DDDT)_2]$, the space group is P anti 1, a = 9.126 (6) A, b = 13.519 (9) A, c = 13,723 (5) A, α = 86.31 (4)°, β = 89.59 (4)°, γ = 77.58 (5)°, V = 1650 (2) A (2) A^3, and Z = 2. 11 references, 6 figures, 6 tables.

37163 Iron-57 Moessbauer spectra of $MnFeF_5$ x $2H_2O$. Karraker, D.G. (E. I. du Pont de Nemours and Company, Aiken, SC (USA)). *Inorganic Chemistry;* **26**: No. 22, 3814-3816(4 Nov 1987). Contract AC09-76SR00001.

Results of a recently reported low-temperature magnetic susceptibility study of $MnFeF_5$ x $2H_2O$ showed a transition to ferromagnetic ordering at 38 +- 0.25K. These magnetic studies have now been extended by Moessbauer spectroscopy to the temperature range 4.2 - 53K. The Moessbauer parameters for $MnFeF_5$ x $2H_2O$ did not show the transition below the critical temperature, T/sub c/, reported by other workers for Fe_2F_5 x $2H_2O$; however, the quadrupole-splitting constant in the paramagnetic region of the spectrum was essentially the same as that previously reported for Fe^{2+} in Fe_2F_5 x $2H_2O$. The magnetic properties of Fe^{2+} in $MnFeF_5$ x $2H_2O$ are very similar to those of Fe^{2+} in Fe_2F_5 x $2H_2O$. 11 references, 4 figures, 1 table.

37164 Halide-promoted formation and carbonylation of μ_3-nitrene ligands on Ru_3 clusters. Han, S.H.; Geoffroy, G.L.; Rheingold, A.L. (Pennsylvania State Univ., University Park (USA)). *Inorganic Chemistry;* **26**: No. 21, 3426-3428(21 Oct 1987).

Results of work reported herein show that halides dramatically promote nitrene carbonylation to form isocyanates. Halides have also been found to accelerate the formation of nitrene ligands from nitrobenzene. Reasons for the halide promotion are unknown; however, it is suggested that the halides facilitate the reaction by labilizing the Ru-N bond to form a dibridging nitrene that then undergoes nucleophilic attack on a coordinated carbonyl. 16 references, 1 figure.

37165 Structure of $MnPO_4$ x H_2O by synchrotron x-ray powder diffraction. Lightfoot, P.; Cheetham, A.K.; Sleight, A.W. (Univ. of Oxford (England)). *Inorganic Chemistry;* **26**: No. 21, 3544-3547(21 Oct 1987).

The crystal structure of $MnPO_4$ x H_2O has been determined from high-resolution synchrotron X-ray powder diffraction data. The powder pattern was indexed on the basis of 20 accurately measured reflections by an automatic indexing program. Integrated intensities were obtained for 61 unambiguously indexed reflections and used to generate a Patterson map from which the position of the manganese atom was determined. The remaining non-hydrogen atoms were located by Fourier methods, and the hydrogen atom was placed geometrically and refined without constraints. Refinement of the entire diffraction profile, by the Rietveld method, converged to final agreement factors R/sub wp/ = 0.161, R/sub p/ = 0.122, and R/sub I/ = 0.047. The compound crystallizes in the monoclinic space group, C2c, with lattice parameters a = 6.912 (1) A, b = 7.470 (1) A, c = 7.357 (1) A, β = 112.3 (1)°, and Z = 4. The structure consists of axially distorted MnO_6 octahedra linked together, through the oxygen atom of the water molecule at a common vertex, to form zigzag-Mn-O-Mn-chains running parallel to [101]. These chains are interconnected by PO_4 tetrahedra to form a continuous three-dimensional network. 27 references, 5 figures, 2 tables.

37166 Characterization of hydrogen adsorption on palladium and Pd/C using a radiotracer. Loh, K.; Tang, Y. (Industrial Technology Research Institute, Hsinchu (Taiwan)). *Journal of the Chinese Chemical Society (Taipei);* **34**: No. 3, 231-235(Sep 1987).

Hydrogen adsorption on palladium black and palladium supported on activated carbon was characterized by the Temperature Programmed Desorption technique (TPD) using the radiotracer tritium. It is shown that there are five energetic desorbed hydrogens with peak maxima at -50, 35, 115, 350, and 580°C. An additional peak at -120°C hydrogen desorbed from activated carbon was observed on Pd/C. An isotopic hydrogen separation experiment was designed to demonstrate that hydrogen only dissociatively adsorbed on palladium surfaces whereas it was associatively adsorbed on activated carbon.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 35969, 37147, 37180, 37214

37167 (DOE/ER/13387—37) Organic redox phototransformations at chemically-modified surfaces: Progress report. (Texas Univ., Austin (USA). Dept. of Chemistry). 1988. Contract FG05-85ER13387. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008650/JAW.

Work has continued on the mechanistic characterization of new chemical transformations of organic molecules at native and chemically-modified surfaces. New electrodes are being prepared by adsorption, covalent attachment, polymerization, mulling and sputtering with electroactive and light sensitive materials. Photocatalytic oxidation of organic substrates occurs with high chemical yield on irradiated semiconductor surfaces. Photocatalysis has been defined for several functional groups.

37168 (DOE/ER/13387—37A) Organic redox phototransformations at chemically modified surfaces: Progress report, August 1985-January 1988. Fox, M.A. (Texas Univ., Austin (USA). Dept. of Chemistry). 1 Feb 1988. Contract FG05-85ER13387. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008649/JAW.

This research program has involved mechanistic studies of new chemical transformations of organic molecules at native and chemically modified surfaces. New electrode materials have been prepared by adsorption, covalent attachment, polymerization, and mulling with electroactive and with light-sensitive materials. Physical characterization of these designed surfaces have been studied by rapid kinetic methods. Catalytic organic reactions initiated by electron exchange on these three-dimensional arrays have been sought, and mechanistic studies of prime candidiates for efficient electrocatalysis. 9 figs.

37169 (SAND—87-2082C;J) The kinetics of charge-transfer reactions on passive lithium electrodes. Delnick, F.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 19p. (CONF-880598—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009256/JAW.

From 4. international meeting on lithium batteries; Vancouver, Canada (23 May 1988).

Lithium anodes are covered by LiCl passive films in $SOCl_2$ solutions. At open-circuit, film growth is controlled by electronic

processes within the film. Under discharge, solid-state ionic processes control the kinetic behavior of the electrode. These processes are not independent of one another. In this report, the interaction of electronic and ionic processes in LiCl passive films is reviewed. Special attention is directed to the role of lattice imperfections in establishing and controlling the mechanisms of electronic and ionic charge transport. 17 refs.

37170 **Interfacial electron-transfer reactions between platinum colloids and reducing radicals in aqueous solution.** Harriman, A.; Millward, G.R.; Neta, P.; Richoux, M.C.; Thomas, J.M. (Royal Institution, London (England)). *Journal of Physical Chemistry;* **92**: No. 5, 1286-1290(10 Mar 1988).

Cyclic voltammetry has been used to evaluate redox potentials, diffusion coefficients, and heterogeneous electrochemical rate constants for reducing radicals derived from various N-methylbipyridinium ions, N-methylpyridinium ions, aryl ketones, and p-nitrobenzoate ion in aqueous solution. The absorption spectra, rates of formation, and stabilities of these radicals have been determined by pulse radiolytic techniques. All the above radicals transfer an electron to colloidal Pt particles (characterized by high-resolution electron microscopy), and the bimolecular rate constants for such interfacial reactions have been measured under pulser radiolytic conditions. The magnitude of these rate constants is found to depend upon a number of factors related to both mass-transfer and surface processes.

37171 **Technetium electrochemistry. 5. Spectroelectrochemical studies on the hexachlorotechnetate(IV) and hexabromotechnetate(IV) complexes in aqueous media.** Huber, E.W.; Heineman, W.R.; Deutsch, E. (Univ. of Cincinnati, OH (USA)). *Inorganic Chemistry;* **26**: No. 22, 3718-3722(4 Nov 1987). Contract AC02-80EV10380.

Thin-layer spectroelectrochemical techniques have been employed to show that the TcX_6^{2-} (X = Cl, Br) complexes undergo a reversible one-electron reduction in concentrated HX/NaX aqueous media (typically, 2.0 M HX and 3.0 M NaX). A single 4-min Tc(IV) → Tc(III) → Tc(IV) cycle in the thin-layer cell generates a completely equilibrated $TcX_6^{2-}/TcX_5(H_2O)^-$ Tc(IV) system, even though these substitution-inert Tc(IV) complexes normally require several days to reach equilibrium at room temperature. Spectropotentiostatic experiments conducted as a function of $[H^+]$ and $[H^-]$ show that the bromo system is 160 mV easier to reduce than is the chloro system and that both hydrogen and halide ions are lost from the Tc center upon reduction from Tc(IV) to Tc(III). The numbers of H^+ ions lost from the chloro and bromo systems are 1.2 +/- 0.1 and 1.6 +/- 0.3, respectively; the number of chloride ligands lost is 2.7 +/- 0.1, while the number of bromide ligands lost is 5.9 +/- 0.5. A general reaction scheme consistent with these results is presented, and implications are drawn about the relatively high lability and low halide affinity of the Tc(III) center in aqueous media. 28 references, 6 figures, 1 table.

4005 Photochemistry

REFER ALSO TO CITATION(S) 35906, 35969, 35970, 36933, 36944, 37061, 37112, 37155, 37167, 37168, 37195, 37231, 38296

37172 **(BNL—41103) Multiphoton ionization of alkaline earth atoms in an intense laser field.** Kim, D.; DiMauro, L.F. (Brookhaven National Lab., Upton, NY (USA); Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-880435—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008078/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

We have studied the single and double nonresonant multiphoton ionization of calcium atom using both 532-nm and 1.06μm radiation. These studies were conducted in the intensity regime of 10^{10-13} Wcm^2. We use mass and angularly resolved electron energy analysis in an attempt to gain insight into the dominant mechanisms responsible for ionization. 3 figs., 1 tab.

37173 **(DOE/ER—13633-2) Energy conversion processes based on molecular excited states: Progress report, August 1, 1987-July 31, 1988.** Meyer, T.J. (North Carolina Univ., Chapel Hill (USA)). Mar 1988. Contract FG05-86ER13633. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008126/JAW.

The first of the two interwoven threads of our DOE-supported research efforts include studies on the preparation and photochemical properties of transition metal complexes which have metal to ligand charge transfer excited states. In sight is being gained into the electronic structure and photochemical and photophysical properties of these excited states. The second emphasis in our work has been on the preparation and characterization of thin polymeric films which contain these complexes. The goal is to learn how to vary the underlying microstructure as a basis for energy conversion applications at the molecular level. 10 refs.

37174 **(DOE/ER—60552-1) Chemical interactions of polycyclic organic compounds with coal fly ash and related solid surfaces: Progress report, July 1, 1987-June 30, 1988.** Mamantov, G.; Wehry, E.L. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Jan 1988. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008125/JAW.

The principal objective is to characterize the interactions of polycyclic aromatic hydrocarbons (PAHs) and their derivatives with the surfaces of coal ash particles (and those of other atmospheric particulate solids), with particualr emphasis on the photochemical degradation of adsorbed PAHs. We deposit PAHs from the vapor phase onto the surfaces of particulate solid in order to mimic, as closely as possible under laboratory conditions, the process whereby PAHs generated in the vapor phase by combustion sources subsequently deposit onto atmospheric particulate matter. Previous investigations have shown that coal ash surfaces stabilize PAHs to photodecomposition. These coal ashes highest in carbon and/or iron content tend to be most effective in stablizing PAHs to phototransformation. Such observations imply that PAHs present as adsorbates on particulate surfaces have significantly greater atmospheric residence times than had previously been assumed. 18 refs.

37175 (RISO-M—2630, pp 117-127) **Oxidant formation in the photolysis of the NO_3^- ion in aqueous solutions.** Herrmann, H.; Karthaeuser, J.; Zellner, R. (Institut fuer Physikalische Chemie, Universitaet Goettingen (DE)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37176 **Photodissociation study of 1,3-butadiene.** Sellers-Hann, L.; Krailler, R.E.; Russell, D.H. (Department of Chemistry, Texas A&M University, College Station, Texas 77843). *Journal of Chemical Physics;* **89**: No. 2, 889-896(15 Jul 1988).

Laser-ion beam photodissociation is used to study the $C_4H^+_6$ radical cation formed by electron impact (70 eV nominal energy) ionization of 1,3-butadiene. The kinetic energy release value obtained from $C_4H^+_6 \rightarrow C_3H^+_3 + CH_3$ does not agree with the distribution reported by Farrar [J. Chem. Phys. 77, 263 (1982)]. The photodissociation studies of $C_4H^+_6$ suggest the existence of a long-lived ($>0.05 \times 10^{-6}$ s) photoexcited $C_4H^+_6$ ion. Also, results of photodissociation studies of $C_4H^+_6$ trapped in the electron beam space charge are consistent with the proposed long-lived photoexcited $C_4H^+_6$ ion. Therefore, it is proposed that the two-photon photodissociation of $C_4H^+_6$ reported by Baer [J. Chem. Phys. 85, 6361 (1986)] is a sequential two-step process involving a long-lived excited $C_4H^+_6$ ion.

37177 **Reaction paths for the dissociation a-italic-tilde $^3A''$ $CH_2CO \rightarrow X\ ^3B_1\ CH_2 + X\ ^1\Sigma^+\ CO$.** Allen, W.D.; Schaefer H.F. III. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550, and Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* 89: No. 1, 329-344(1 Jul 1988).

An ab initio investigation of the (C/sup II//sub s/) in-plane bent $^3A''$ $CH_2CO \rightarrow X\ ^3B_1\ CH_2 + X$ ^{1}summation$^+$ CO and the (C/sup I//sub s/) out-of-plane bent $^3A'$ $CH_2CO \rightarrow X\ ^3B_1\ CH_2 + X$ ^{1}summation$^+$ CO dissociation paths has been performed. Geometrical structures, vibrational frequencies, and quadratic force constants have been determined at the DZP SCF and DZP CISD levels of theory for the X $^1A_1$, $^3A''$, and $^3A'$ states of ketene and for the $^3A''$ and $^3A'$ transition states for dissociation. The DZP CISD structure for A-italic-tilde $^1A''$ ketene is also reported. Final energetic predictions for triplet ketene dissociation have been obtained from large-basis (QZ2P and QZ2P+f) UMP4(SDTQ) calculations at the DZP CISD geometries. The C/sup II//sub s/ stationary point for $^3A''$ ketene dissociation is a true transition state with r(C—C) = 2.071 A at the DZP CISD level of theory. The corresponding C/sup I//sub s/ stationary point for $^3A'$ ketene is actually a super transition state for the interconversion of two equivalent $^3A''$C/sup II//sub s/ transition states for dissociation.

37178 **Dimethylsilylene: spectroscopy, reactivity, and complexation in fluid solutions.** Levin, G.; Das, P.K.; Lee, C.L. (Dow Corning Corp., Midland, MI (USA)). *Organometallics;* 7: No. 5, 1231-1232(May 1988).

Upon 266-nm laser flash photolysis, cyclohexane solutions of dodecamethylcyclohexasilane give rise to a transient species (λ/sub max/ = 465 nm) that is best assigned as dimethylsilylene. This species exhibits unusually high reactivity toward alcohols and reagents containing Si-H, C=C, and C identical with C bonds (with rate constants in the limit of diffusion control) and readily forms complexes with lone-pair containing molecules (ethers, triethylamine, and acetonitrile), the latter showing considerably reduced reactivity relative to the free silylene.

37179 **Scintillation process in three-component systems: mechanism of the luminescence minimum.** Yoshida, Y.; Lipsky, S. (Univ. of Minnesota, Minneapolis (USA)). *Journal of Physical Chemistry;* 92: No. 8, 2240-2248(21 Apr 1988).

Three-component systems consisting of a saturated hydrocarbon solvent, C, an aromatic solvent, B, and a fluorescent solute, T, are excited either optically (in the absorption band of C and below its ionization potential) or with 0.67-MeV β^- particles. The luminescence of T is detected and studied as a function of the B/C concentration ratio. Systems studied are C = cyclohexane, trans-decalin, methylcyclohexane, bicyclohexyl, n-heptane, or 2,3-dimethylbutane; B - benzene or toluene; and T = N,N,N',N'-tetramethylphenylenediamine (TMPD), p-terphenyl, or 2,5-diphenyloxazole (PPO). The luminescence behavior is observed under both aerated and nitrogenated conditions. For B = benzene, the luminescence of T is depressed by the replacement of C with B, at low B/C concentration ratios. This occurs for both modes of excitation for all C except bicyclohexyl and 2,3-dimethylbutane. At higher B/C concentration ratios, the luminescence of T recovers and ultimately exceeds its intensity in pure C + T. Thus there is observed a luminescence minimum. At low T concentrations the position and depth of the minimum are very sensitive to the presence of O_2, but at higher concentrations this sensitivity is lost. For B = toluene, the luminescence minimum is only observed under β^- particle excitation conditions. A mechanism is developed to accommodate these observations. Its analysis indicates that production of S_1 states of B (i.e., B*) via either energy transfer from C* or via charge transfer from C^+ followed by the geminate recombination $B^+ + e^- \rightarrow B^*$ is intrinsically inefficient in dilute cyclohexane solutions. For B = benzene this inefficiency resides mainly in the electronic energy transfer process and for toluene in the ion-recombination process. Also, the analysis indicates that there must be two states of C that can transfer energy to B and/or T.

37180 **Photoelectrochemistry in particulate systems. 7. Electron-transfer reactions of indium sulfide semiconductor colloids.** Kamat, P.V.; Dimitrijevic, N.M.; Fessenden, R.W. (Univ. of Notre Dame, Indiana (USA)). *Journal of Physical Chemistry;* 92: No. 8, 2324-2329(21 Apr 1988).

Small semiconductor colloids of In_2S_3 have been prepared in aqueous and nonaqueous media and their absorption properties characterized. A transient photobleaching and formation of S/sup .-/ and S_2H_3/sup .-/ radicals have been observed upon laser pulse (355 nm) excitation of these colloids. With the aid of transient absorption spectra, the anodic corrosion process in these semiconductor colloids has been elucidated by using laser flash photolysis and pulse radiolysis techniques. With the use of a zwitterionic viologen compound, the interfacial charge-transfer process at the semiconductor surface has been studied. The quantum yield for the reduction of zwitterionic viologen was 0.07, which is similar to the value obtained with other metal chalcogenide semiconductor colloids. The microenvironment of the stabilizer (Nafion) influenced the charge-transfer process between the semiconductor and the redox decay.

37181 **Intramolecular excited-state electron transfer in a covalently linked porphyrin-viologen molecule: direct observation of the charge-separated intermediate by resonance Raman spectroscopy.** McMahon, R.J.; Force, R.K.; Patterson, H.H.; Wrighton, M.S. (Massachusetts Institute of Technology, Cambridge (USA)). *Journal of the American Chemical Society;* 110: No. 8, 2670-2672(13 Apr 1988).

The authors wish to report the observation of intramolecular excited-state electron transfer in porphyrin-viologen 1 by resonance Raman (RR) spectroscopy. The literature contains numerous examples of photochemical studies of porphyrins covalently linked to various electron acceptor units. Other workers have investigated long-range excited-state electron transfer in rigid model systems. In many instances, electron-transfer quenching of the porphyrin excited state has been inferred from fluorescence quenching experiments or lifetime measurements. Both fluorescence quenching and shortened lifetimes may result from processes other than electron transfer, however. Direct evidence for excited-state electron transfer requires techniques such as absorption spectroscopy or ESR spectroscopy. For example, in a series of porphyrin-viologen molecules related to 1 it was found that fluorescence quenching does occur, but the data were inconclusive with respect to whether the quenching results in electron transfer to the viologen center. They now describe a study in which they correlate the typical fluorescence and lifetime because the reduced viologen, Bz_2V/sup .+/ is easily detected by RR spectroscopy. Importantly, the porphyrin-viologen system appears to yield relatively long-lived charge-separated species following photoexcitation.

37182 **Effects of molecular organization on photophysical behavior. Time-resolved fluorescence of a pyrene-labeled phosphatidylcholine in spread monolayers of dioleoylphosphatidylcholine.** Bohorquez, M.; Patterson, L.K. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* 92: No. 7, 1835-1839(7 Apr 1988).

The time-resolved behavior of 1-(6-pyreneylhexanoyl)-2-palmitoyl-sn-glycero-3-phosphocholine (1-PyPC) has been examined in spread of monolayers of dioleoylphosphatidylcholine (DOL) at the N_2-water interface as functions of concentration of 1-PyPC and of surface pressure within the layer. Both excited monomer emission at 380 nm and excimer emission at 480 nm were monitored after excitation by a 80-ps pulse at 354 nm. It was found that for first-order processes the rate constants are comparable to those reported for pyrene in cyclohexane. Rate constants for the diffusion-controlled excimer formation exhibit a small but definite dependence on surface pressure and may be used to obtain diffusion coefficients of the probe of (5-7) x 10^{-7} cm^2/s.

37183 **Dynamics of the $(^3CT)Ru(bpy)^{2+}$ relaxation and electron-transfer processes under intense magnetic fields: evidence about the formation of adducts in the MV^{2+} quenching of $(^3CT)Ru(bpy)_3^{2+}$.** Ferraudi, G.; Argueello, G.A. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* 92: No. 7, 1846-1850(7 Apr 1988).

Intense magnetic fields (1-5 T) accelerate the rate of relaxation of $(^3CT)Ru(bpy)_3^{2+}$. The change of the rate constant with field intensity is linear for fields less intense than 4 T, a behavior inconsistent with an interaction mixing precursor and successor states. The rate constants of electron-transfer quenching of the excited state by $Co(NH_3)_5Cl^{2+}$, $Co(C_2O_4)_3^{3-}$ experience also field-induced changes which can be associated with variations in the value of the electronic coupling matrix element. The quenching by methylviologen, investigated by flash photolysis, has shown the presence of an intermediate in a microsecond time domain, and the quenching rate constant experienced a significant magnetic-field-induced deceleration.

37184 **Kinetics for electron transfer from laser-pulse-irradiated colloidal semiconductors to adsorbed methylviologen. Dependence on the quantum yield on incident pulse width.** Nosaka, Y.; Fox, M.A. (Technological Univ. of Nagaoka (Japan)). *Journal of Physical Chemistry;* **92**: No. 7, 1893-1897(7 Apr 1988).

The dependence of the quantum yield for reduction of adsorbed methylviologen Phi on the pulse width Δt and intensity of the incident laser pulse was measured on colloidal CdS stabilized with poly(acrylic acid) and on colloidal TiO_2 stabilized with poly)vinyl alcohol). The relationship among Phi, Δt, the laser intensity, and the rate constants for electron transfer (k/sub e/), hole decay (k/sub h/), and electron-hole recombination (k/sub r/) was deduced from a quantitative reaction kinetics model. On colloidal TiO_2, differences in Phi were observed for 30-ps and 10-ns incident pulses, requiring that k/sub e/ $> 10^{10}$ s^{-1}, k/sub h/ $> 10^{10}$ s^{-1}, and k/sub r/ $> 10^{-8}$ cm^3 s^{-1}. On colloidal CdS, however, no dependence of Phi on Δt was observed, indicating that k/sub e/ $> 3 \times 10^{11}$ s^{-1}, k/sub r/ $< 3 \times 10^{-7}$ cm^3 s^{-1}, and k/sub h/k/sub e/ $< 10^{-3}$.

37185 **Intramolecular photochemical electron transfer. 4. Singlet and triplet mechanisms of electron transfer in a covalently linked porphyrin-amide-quinone molecule.** Schmidt, J.A.; McIntosh, A.R.; Weedon, A.C.; Bolton, J.R.; Connolly, J.S.; Hurley, J.K.; Wasielewski, M.R. (Univ. of Western Ontario, London (Canada)). *Journal of the American Chemical Society;* **110**: No. 6, 1733-1740(16 Mar 1988). Contract AC02-83CH10093;W-31-109-ENG-38.

The authors have carried out an extensive photophysical analysis of a tetraarylporphine linked through a single amide bridge to either methyl-p-benzoquinone (PAQ) or the corresponding hydroquinone ($PAQH_2$) in benzonitrile as the solvent. The photophysical properties of $PAQH_2$ are closely similar to those of nonlinked tetraarylporphine species, while for PAQ significant lifetime quenching of both the lowest excited singlet and triplet states is observed. Picosecond transient absorption spectroscopy and fluorescence lifetime measurements were used top show that quenching of the excited singlet state of PAQ is due to intramolecular electron transfer to the singlet radical ion pair ^{1}(P/sup .+/AQ/sup .-/) with the rate constant of 4.1 (+-0.3) x 10^9 s^{-1}. ^{1}(P/sup .+/AQ/sup .-/) subsequently decays to the ground state by reverse electron transfer with a rate constant of 1.6 (+- 0.2) x 10^8 s^{-1}. This reaction has $\Delta G^\circ \approx$ -1.4 eV and is predicted by Marcus theory. Nanosecond flash photolysis studies show that the lowest triplet state of PAQ is also quenched, most likely by electron transfer to the triplet radical ion pair ^{3}(P/sup .+/ AQ/sup .-/, with a rate constant of 4.6 (+-0.2) x 10^4 s^{-1}. They suggest that ^{3}(P/sup .+/AQ/sup .-/), which then decays rapidly to the ground state.

37186 **Photoaddition and photoreduction of chloranil with arenes via singlet and triplet excited complexes: effects of irradiation wavelength and radical ion pair spin multiplicity.** Jones, G. II; Haney, W.A.; Phan, X.T. (Boston Univ., MA (USA)). *Journal of the American Chemical Society;* **110**: No. 6, 1922-1929(16 Mar 1988).

The photochemistry of chloranil (Q) in the presence of the arenes hexamethylbenzene, 1-methyl-, 1,3-dimethyl-, 1,4-dimethyl-, and 2,3-dimethylnaphthalene, and acenaphthene has been investigated. Irradiation in a nonpolar solvent provided ether adducts resulting from formal addition of the quinone to the arene side chain, the hydroquinone, (QH_2), and in one case, an identifiable oxidation product, acenaphthylene. The quantum yield for these transformations was shown to have a complex dependence on the concentration of the arene and irradiation wavelength. On irradiation at 366 nm under conditions in which free chloranil absorbs, the preferred product was the reduced species, QH_2. On irradiation at 436 nm under conditions in which the ground-state charge-transfer (CT) complex of Q and the arene chiefly absorbs, the preferred product was the ether adduct. Excitation of complexes at 546 nm resulted in a sharply reduced quantum yield. Flash photolysis studies show that the quenching of Q triplets by the arenes leads to free radicals (QH/sup ./ and DH/sup ./) by a sequential electron-transfer, proton-transfer mechanism. Irradiation of QDH_2 complexes appears alternatively to lead to singlet radical ion pairs (Q/sup .-/, DH_2/sup .+/) which evolve into singlet radical pairs (QH/sup ./, DH/sup ./) and final products in competition with back reactions which return radical pairs to ground-state reactants.

37187 **Photosensitization of triplet carotenoid in photosynthetic light-harvesting complex of photosystem II.** Nechushtai, R.; Thornber, J.P.; Patterson, L.K.; Fessenden, R.W.; Levanon, H. (Univ. of California, Los Angeles (USA)). *Journal of Physical Chemistry;* **92**: No. 5, 1165-1168(10 Mar 1988).

A laser photolysis study, on the nanosecond time scale, has been carried out on the major light-harvesting chlorophyll-protein complex of photosystem II (LHC IIβ). The transient triplet absorption of the isolated LHC IIβ has been compared to those of its constituent chromophores in dilute micellar aqueous solutions, namely, chlorophyll a, chlorophyll b, chlorophyll a + chlorophyll b, and chlorophyll a + β-carotene. The results indicate that the carotenoid in the LHC IIβ is photosensitized by triplet chlorophyll a and that the decay of the transient triplet absorption exhibits two transients, one in the ~ 50-ns range and the other in the ~ 10μs time scales. The former transient is light-intensity dependent and is attributed to an annihilation process between two triplets of chlorophyll a, while the latter is due to the decay of the triplet carotenoid to its ground state.

37188 **FT ESR study of photoinduced electron transfer.** Prisner, T.; Dobbert, O.; Dinse, K.P.; van Willigen, H. (Univ. of Dortmund (West Germany)). *Journal of the American Chemical Society;* **110**: No. 5, 1622-1623(2 Mar 1988). Contract FG02-84ER13242.

With Fourier transform ESR (FT ESR) well resolved spectra of organic free radicals can be obtained even if the free induction decay, following a $\pi/2$ microwave pulse, is as short as 1 μs. This makes the technique particularly suitable for the study of short-lived radicals. Results are presented of a FT ESR study of a transient free radical generated in a reversible photoinduced electron transfer reaction. The reaction and spin dynamics have been monitored from the time the radical is generated with nanosecond time resolution. The technique provides data complementary to those provided by flash photolysis.

37189 **Variable photon energy photoelectron spectroscopic studies of copper chlorides: an experimental probe of metal-ligand bonding and changes in electronic structure on ionization.** Didziulis, S.V.; Cohen, S.L.; Gewirth, A.A.; Solomon, E.I. (Stanford Univ., CA (USA)). *Journal of the American Chemical Society;* **110**: No. 1, 250-268(6 Jan 1988).

Variable photon energy photoelectron spectra (PES) are reported for the valence band region of cuprous and cupric chlorides for photon energies between 22 and 1253.6 eV. Intensity changes of the PES peaks observed with variation of photon energy are associated with (1) the photoionization cross sections of Cu 3d and Cl 3p atomic orbitals, (2) the Cooper minimum of the Cl 3p orbitals, and (3) resonance effects at the Cu 3p absorption edge. These effects allow a definitive assignment of specific PES features, an experimental estimate of covalent mixing between metal and ligand orbitals for all valence levels, and a quantitative evaluation of relaxation effects on the ionized final states. The intensity changes of the $CuCl_4^{2-}$ PES peaks are found to be dramatically different from those of $CuCl_4^{2-}$, a result of increased covalent mixing in the cupric chlorides. Quantitative analysis of the PES data indicates that in D/sub 4h/$CuCl_4^{2-}$, the highest energy level has less covalent mixing

than the D/sub 4h/ salt (68% Cu 3d character), while the mixing averaged over all the metal levels increases (76% Cu 3d).

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 37148, 37179, 37180, 37645, 37646, 37932, 37933, 37934, 37935, 37936

37190 **(AERE-R—12798) Radiolytic oxidation. Progress report 1st January 1987 to 1st July 1987.** Ewart, F.T.; Hall, K.R.R.; Smith, A.J.; Walters, W.S.; Williams, S.J. (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Feb 1988. 14p. (DOE-RW—87.117). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753505/JAW.

Progress made under the Radiolytic Oxidation contract during the period January to June 1987 is reported. Further work on irradiation of neptunium (IV) hydroxide by ^{60}Co confirms that in concrete waters of high pH radiolytic oxidation is unlikely to be important although at pH values less than 12 evidence for oxidation has been noted. The feasibility of monitoring U(IV) oxidation to U(VI) by measuring the total uranium concentration in solution has been demonstrated. Some work in other areas of the programme is briefly described.

37191 (GSI—87-11, pp B1.1-B1.4) **Physical and chemical structure of charged particle tracks in liquid water.** Wright, H.A.; Hamm, R.N.; Turner, J.E.; Magee, J.L.; Chatterjee, A. (Oak Ridge National Lab., TN (USA). Health and Safety Research Div.; Lawrence Berkeley Lab., CA (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—). Contract AC05-84OR21400;W-7405-ENG-48.

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37192 (GSI—87-11, pp B3.1-B3.4) **Production of HO_2 in the radiolysis of water with heavy ions.** LaVerne, J.A.; Schuler, R.H. (Notre Dame Univ., IN (USA). Dept. of Chemistry; Notre Dame Univ., IN (USA). Radiation Lab.). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37193 **(IPEN-Pub—125) Mathematical model applied to decomposition rate of RIA radiotracers: ^{125}I-insulin used as sample model.** Mesquita, C.H. de; Hamada, M.M. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Sep 1987. 17p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702401/JAW.

A mathematical model is described to fit the decomposition rate of labelled RIA compounds. The model was formulated using four parameters: one parameter correlated with the radioactive decay constant; the chemical decomposition rate 'K/sub */' of the radiolabelled molecules; the natural chemical decomposition rate 'K' and; the fraction 'f/sub */' of the labelled molecules in the substrate. According to the particular values that these parameters can assume, ten cases were discussed. To determine one of these cases which fit the experimental data, three types of samples were need: radioactive; simulated radiotracer ('false radiolabelled') and; on labelled common substrate. The radioinsulin ^{125}I was used as an example to illustrate the model application. The experimental data substantiate that the insulin labelled according to the substorchiometric procedures and kept at freezer temperature were degraded with K=0.45% per day.

37194 **(JINR—12-87-712) Effect of accelerated heavy ions on polycarbonate.** Aprel', P.Yu.; Kravets, L.I.; Kuznetsov, V.I.; Didyk, A.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702899/JAW.

Submitted to the journa High Energy Chem.

The radiation-chemical processes in polycarbonate film irradiated with nitrogen and xenon ions (energy ca. 1 MeV/nucleon) were investigated. The method of chemical etching monitored by measuring the electrical conductivity of the film was used for the study of structure and size of tracks. Basing on the comparison of conductometric, spectrophotometric and viscosimetric data it has been found that under the ion-irradiation the processess of destruction and cross-linking occur simultaneously in polycarbonate. The destruction predominates in the track core with a diameter of a few nanometers. The effects related to the formation of cross links between macromolecular chains appear at the distances of 5-30 nm from the path of a heavy ion. The hypothesis is suggested that such a distribution of the chain scission and cross-linking events could be typical for other polymers. 19 refs.; 4 figs.

37195 **Pulse radiolysis study to probe reduced platinum colloids in aqueous solution using optical and conductivity techniques.** Rabani, J.; Fessenden, R.W.; Sassoon, R.E. (Hebrew Univ., Jerusalem (Israel)). *Journal of Physical Chemistry;* **92**: No. 8, 2379-2385(21 Apr 1988).

Measurements of conductance changes accompanying the pulse radiolysis of aqueous solutions containing 2-propanol, methylviologen (MV^{2+}), and colloidal Pt (Ptc) have been carried out in parallel with optical absorption measurements on the same systems in order to investigate the reactions involved in the loading of Ptc with reducing equivalents. Two stages could be distinguished in the equilibration of MV^+, MV^{2+}, H^+, H_2, and Ptc. The faster process, which was over in about 6 ms, is attributed to the equilibrium involving MV^+, MV^{2+}, and H^+ with Ptc while the slower process which takes ~ 100 ms or more, is suggested to involve H_2 produced by radiolysis. At pH values in the range 9-11, the conductivity signal was found to decay more slowly and to a smaller extent than the optical absorption. Thus the injection of charge into the catalyst particle is faster than the protonation of the charged catalyst. The number of protons absorbed per electron increases with time to a value of about 0.7. Optical experiments at near-neutral pH suggested the adsorption of MV^{2+} on the catalyst to be important.

37196 **Critical Review of rate constants for reacitons of hydrated electrons.** Buxton, G.V.; Greenstock, C.L.; Phillips Helman, W.; Ross, A.B. (Theoretical Astrophysics 130-33, California Institute of Technology, Pasadena, California 91125). *Journal of Physical and Chemical Reference Data;* **17**: No. 2, 513-886(Apr 1988).

Kinetic data for the radicals Hx and xOH in aqueous solution,and the corresponding radical anions, xO^- and e/sub =/, have been critically reviewed. Reactions of the radicals in aqueous solution have been studied by pulse radiolysis, flash photolysis and other methods. Rate constants for over 3500 reaction are tabulated, including reaction with molecules, ions and other radicals derived from inorganic and organic solutes.

37197 **Radical cations in pulse radiolysis of liquid alkanes. Time-resolved fluorescence detected magnetic resonance.** Werst, D.W.; Trifunac, A.D. (Argonne National Lab., IL (USA)). *Journal of Physical Chemistry;* **92**: No. 5, 1093-1103(10 Mar 1988).

Alkane and olefin radical cations are characterized by time-resolved fluorescence detected magnetic resonance (FDMR) in pulse radiolysis of neat alkane liquids and binary alkane mixtures at room and low temperatures (~ 180K). FDMR-EPR spectra of the cis-decalin radical cation and the norbornane radical cation are detected a low concentrations (10^{-3}-10^{-1} M) of cis-decalin and norbornane, respectively, in alkane mixtures. Parent minus H_2 olefin radical cations are observed in neat alkanes and in alkane mixtures. Studies of the temperature and concentration dependences of olefin cation formation suggest that olefin cations originate in the fragmentation of parent alkane cations and that this reaction depends on the energy content of the parent cation. Other possible reactions of alkane radical cations are discussed.

37198 **Geminate radical ions in polar solvent radiolysis. Time resolved fluorescence detected magnetic resonance (FDMR).** Percy, L.T.; Werst, D.W.; Trifunac, A.D. (Argonne National Lab., IL (USA)). *Radiation Physics and Chemistry, International Journal of Radiation Applications and Instrumentation Part C;* **32**: No. 2, 209-213(1988). Contract W-31-109-ENG-38.

Several polar liquids, dioxane, tetrahydrofuran, 1 and 2-propanol, 1-butanol, amyl alcohol and ethylene glycol were irradiated with 3MeV electron pulses and the presence of geminate ion pairs studied by fluorescence detected magnetic resonance (FDMR). Analysis of the FDMR spectra demonstrates production of excited states by recombination of geminate radical ion pairs and allows differentiation between different pathways leading to the production of excited states. (U.K.).

37199 **Computer simulation of the kinetics of gamma radiolysis of sodium tetraphenylborate solutions.** Gupta, A.K.; Hanrahan, R.J.; Walker, D.D. (Univ. of Florida, Gainesville, (USA)). pp 3 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Major products and corresponding G values in the Co-60 gamma radiolysis of 0.05 M sodium tetraphenylborate (NaTPB) solutions at 25°C are hydrogen (0.46), biphenyl (2.0), benzene (1.3), and phenol (0.41). A dose of 4.4 Mrad increased the pH from 8.2 (initial) to 9.2. A reaction scheme based on formation of H-, OH-, and e/sub aq/- with standard literature G-values was examined using computer modeling. Rapid electron transfer from TPB^- to OH- was assumed, forming OH^- and an unstable transient $B(C_6H_5)_4$ which decomposes to $B(C_6H_5)_3$ plus phenyl radical. Combination reactions between H-, OH-, and C_6H_5- form the observed products with yields matching observation within ca. 25%.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 35733, 37281, 38245, 38246, 38247, 38250, 38454, 38466, 38467, 38551, 38583

37200 **(CEGB-TPRD/B—0975/R87) Passivation of uranium metal surfaces by nitrogen bombardment - the formation of uranium nitride.** Allen, G.C.; Holmes, N.R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753605/JAW.

To be published in the Journal of Nuclear Materials.

As part of a detailed investigation of the behaviour of metallic uranium in various atmospheres, we have examined the reaction between nitrogen gas and uranium metal. At room temperature there was no evidence of reaction between nitrogen gas and a clean metal surface; the only changes observed could be attributed to reaction between the metal and traces of oxygen (less than 0.1 ppm) in the nitrogen gas. Reaction between the metal and nitrogen was induced however by accelerating nitrogen towards the surface using a fast atom gun. The resulting nitrided surface was characterised by X-ray photoelectron spectroscopy, and its oxidation behaviour was monitored over an extended period in UHV and in air.

37201 **(CONF-880435—9) Resonance ionization mass spectrometric study of the promethium/samarium isobaric pair.** Shaw, R.W.; Young, J.P.; Smith, D.H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008083/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

Samarium daughters are problematic in isotope ratio measurements of promethium because they are isobaric. Resonance ionization mass spectrometry was utilized to circumvent this problem. An ionization selectivity factor of at least 1000:1 has been measured for promethium over samarium at 584.6 nm. Resonance ionization spectra have been recorded for both elements over the 528-560 and 580-614 nm wavelength ranges.

37202 **(GSI—87-71-Prepr.) Search for lawrencium as a p-element using gaschromatography techniques.** Jost, D.T.; Gaeggeler, H.W.; Vogel, C.; Eichler, B.; Gregorich, K.E.; Hoffman, D.C.; Schaedel, M.; Jaeger, E. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Paul Scherer Inst. (PSI), Wuerenlingen (Switzerland); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Lawrence Berkeley Lab., CA (USA)). Oct 1987. 16p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.

Multidimensional relativistic Dirac-Fock calculations predict that the last member of the actinides series, Lr, might behave like a p-element with a [Rn] $5f^{14}$ $7s^2$ $7p_12$ ground state electronic configuration, rather than the traditionally expected [Rn] $5f^{14}$ 6d $7s^2$ configuration. On-line gaschromatography was applied to search for Lr as a volatile p-element. These investigations were performed with ^{260}Lr (t_12 = 3 min), produced in the $^{249}Bk(^{18}O,\alpha3n)$ reaction. Quartz and Pt chromatography columns were used. No evidence for Lr as a volatile element was found under reducing conditions and at a temperature of about 1000°C. Our results give a lower limit for the adsorption enthalpy -ΔH/sub a/ for Lr on quartz and Pt surfaces of 290 kJmol. This value is significantly higher than the estimated values for Lr(p).

37203 **(IPEN-Pub—121) Determination of the radiochemical purity of ^{51}Cr-EDTA.** Toledo e Souza, I.T. de; Pereira, N.P.S. de. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Aug 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702398/JAW.

The miniature chromatography systems were elaborated to determine the radiochemical purity chromium ^{51}Cr-EDTA. Chromatography results using four different solvents were obtained and studied. 33% WV aqueous solution of ammonium sulfate pH 7.5 gives the best chemical separation was concluded.

37204 **(IPEN-Pub—123) Synthesis of 2,6-diisopropylphenylcarbamoylmethyl-iminodiacetic acid (DISIDA) and 4-n-p-butyl-phenylcarbamoylmethyl-iminodiacetic acid (BUTYL-IDA). Preparation of lyophilized kit to be used as ^{99}(supm)Tc agent in hepatobiliary system.** Hamada, E.S.; Barbosa, M.F. de; Theodora, M.A.; Almeida, M. de; Colturato, M.T.; Muramoto, E.; Silva, C.P.G. da. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Aug 1987. 14p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702400/JAW.

The synthesis of 2,6 diisopropyl IDA (DISIDA) and 4-n-butyl IDA (BUTIL-IDA) is described. Their spectroscopic properties, radiopharmaceutical preparation and their use as ^{99}(sup m)Tc complex agent in hepatobiliary studies, are also reported.

37205 (JINR-R—7-86-322, pp 16) **Search of spontaneously fissile isotopes of elements 107-110 in products of ^{235}U + ^{40}Ar (205 MeV) interaction by chemical method.** Domanov, V.P.; Timokhin, S.N.; Zhujkov, B.L.; Kim Son Chun; Ajkhler, B.; Chepygin, V.I.; Zvara, I. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

37206 **(NIIAR—15(726)) Remote control and mathematical simulation of ion exchange processes for transplutonium element separation.** Tselishchev, I.V.; Elesin, A.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702951/JAW.

The algorithm has been considered for calculation of the elution curves of the ion-exchange transplutonium element separation processes according to the results from the remote monitoring.

Such calculations make it possible to determine in the course of the process its quality, to estimate both the boundaries for the optimal functioning and the basic technological characteristics. The example of calculations of the curium and americium as well as einsteinium and californium separation processes are presented. 3 refs.; 2 figs.; 1 tab.

37207 **(UCRL—97401) HE^3 outgassing from four working palladium and uranium beds.** Souers, P. C.; Coronado, P. R.; Fearon, F. M.; Garza, R. G.; Shaw , J. F.; Stump, R. K.; Tsugawa, R. T. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 12p. (CONF-880505—25). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011338/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The He^3 output from two palladium and two uranium beds storing T_2 and D-T was studied as a function of time. Three of the beds were started new and watched for a year; the fourth bed was twelve years old. All four were beds used in routine tritium handling. Initial stoichiometries were PdT/sub 0.3/ and UT/sub 0.7/ so that both operated at similar 1 to 130 kPa pressures. The He^3 from palladium ranged from the 0.002 mo1% lower level of sensitivity to 0.01% for PdT_2 at one year of age. The UT system showed 0.1% He^3 at 4 to 62 days and 0.1 to 10% at longer times, with the first cuts being high in He^3. The palladium bed with 95 to 97% pure T_2 enriches the output to as high as 97 to 99%. 9 refs., 1 fig., 2 tabs.

37208 **(UCRL—97402) Increase of tritium permeation through resistant metals at 323 K by lattice defects.** Maienschein, J. L.; McMurphy, F. E.; DuVal, V. L. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 21p. (CONF-880505—24). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011339/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

We report data on tritium permeation at 323 K and 373 K through annealed and single crystal copper for comparison with our earlier data on unannealed copper, and show that tritium transport along grain boundaries or other lattice defects controls the overall rate at 323 K in unannealed material. Measurements on unannealed and annealed gold foil also indicate the importance of defect transport, although with gold we could not reduce the defect concentration sufficiently to measure permeation through the metal lattice. We also include permeation data on aluminum, molybdenum, tungsten, beryllium, cadmium, iridium, lead, rhenium, and silver; all of these were probably dominated by tritium transport along lattice defects. 24 refs., 3 figs., 3 tabs.

37209 **(UCRL—97406) Synthesis and stability of liquid molecular DT.** Souers, P.C.; Fearon, E.M.; Garza, R.G.; Griffith, C.M.; Mayhugh, S.R.; Mapoles, E.R.; Tsurgawa, R.T.; Sater, J.D.; Collins, G.W.; Gaines, J.R. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 17p. (CONF-880505—27). NTIS, PC A17/MF A01;1; GPO Dep. Order Number DE88011349/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Regular equimolar deuterium-tritium is a mixture of 25 mol% T_2-50% DT-25% D_2. We have synthesized molecular DT of greater purity by the reaction $LiT + CH_3OD \rightarrow DT + LiOCH_3$, run at 243{degree}K. With both the alcohol and reactor-to-cryostat transfer lines at room temperature, we obtain 88 mol% DT purity. By cooling the alcohol and holding the transfer lines at 80{degree}K, the yield rose to 95% DT. The DT disproportionated to D_2 and T_2 with a le-time constant of about 100 hours in the liquid at 20.5{degree}K. Nuclear magnetic resonance data showed that the eventual T_2-DT-D_2 equilibrium is probably a {open quotes}hot-atom{close←quotes} one.

37210 **(UCRL—97406-Rev.1) Synthesis and stability of liquid molecular DT.** Souers, P.C.; Fearon, E.M.; Garza, R.G.; Friffith, C.M.; Mayhugh, S.R.; Mapoles, E.R.; Tsugawa, R.T.; Sater, J.D.; Collins, G.W.; Gaines, J.R. (Lawrence Livermore National Lab., CA (USA); Hawaii Univ. at Manoa, Honolulu (USA). Dept. of Physics; Ohio State Univ., Columbus (USA). Dept. of Physics). May 1988. Contract W-7405-ENG-48. 5p. (CONF-880505—27-Rev.1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011723/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Regular equimolar deuterium-tritium is a mixture of 25 mol% T_2-50% DT-25% D_2. We have synthesized molecular DT of greater purity by the reaction $LiT + CH_3OD \rightarrow DT + LiOCH_3$, run at 243{degree}K. With both the alcohol and reactor-to-cryostat transfer lines at room temperature, we obtain 88 mol% DT purity. By cooling the alcohol and holding the transfer lines at 80{degree}K, the yield rose to 95% DT. The DT disproportionated to D_2 and T_2 with a 1e time constant of about 100 h in the liquid at 20.5{degree}K. Nuclear magnetic resonance data showed that the eventual T_2-DT-D_2 equilibrium is probably a {open←quotes}hot-atom{close←quotes} one. 15 refs., 4 figs., 1 tab.

37211 **(UCRL—97513) Tritium labeling of amino acids and peptides with liquid and solid tritium.** Souers, P.C.; Coronado, P.R.; Peng, C.T.; Hua, R.L. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 8p. (CONF-880505—21). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011335/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Amino acids and peptides were labeled with liquid and solid tritium at 21{degree}K and 9{degree}K. At these low temperatures radiation degradation is minimal, and tritium incorporation increases with tritium concentration and exposure time. Ring saturation in L-phenylalanine does not occur. Peptide linkage in oligopeptides is stable toward tritium. Deiodination in 3-iodotyrosine and 3,5-diiodotyrosine occurs readily and proceeds in steps by losing one iodine atom at a time. Nickel and noble metal supported catalysts when used as supports for dispersion of the substrate promote tritium labeling at 21 K. Our study shows that both liquid and solid tritiums are potentially useful agents for labeling peptides and proteins.

37212 **(UCRL—97518) Design of a tritium recovery system.** Sherry, R. J.; Miller, L. C. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 7p. (CONF-880505—23; CONF-880505—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011340/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

A new effluent cleanup system for tritium recovery (abbreviated VERS) has been designed by the Lawrence Livermore National Laboratory for use at their tritium facility in cleaning argon box atmospheres and pump exhausts. It is the standard catalyst-molecular sieve (zeolite) system, and is directly descended from the cleanup system at Mound Laboratory. This paper deals with several topics that represent possible engineering improvements as well as considering several areas of surprise and difficulty.

37213 **Thermal decomposition of curium tetrafluoride and terbium tetrafluoride.** Gibson, J.K.; Haire, R.G. (Oak Ridge National Lab., TN (USA)). *Journal of Solid State Chemistry;* 73: No. 2, 524-530(Apr 1988). Contract AC05-84OR21400.

The thermal decomposition of both curium and terbium tetrafluorides have been studied using mass spectrometry to monitor the effusate from a Knudsen cell containing the condensed fluoride. Curium tetrafluoride was found to decompose at 330-430°C in vacuum. A Second Law enthalpy of 26.3 +/- 2 kcal/mole (at 370°C) is derived from van't Hoff plots of results obtained for the decomposition reaction: $CmF_4(s) \rightarrow CmF_3(s) + 1/2F_2(g)$. Decomposition fluorine pressures are derived and comparison is made with related studies of terbium tetrafluoride carried out in conjunction with the curium experiments. The results are compared both with

data reported in the literature for lanthanide and actinide tetrafluorides and with predictions that have been made for CmF_4.

37214 **Low-symmetry, mixed-valent, μ-oxo technetium complexes with pyridine and halide ligands.** Clarke, M.J.; Kastner, M.E.; Podbielski, L.A.; Fackler, P.H.; Schreifels, J.; Meinken, G.; Srivastava, S.C. (Boston College, Chestnut Hill, MA (USA)). *Journal of the American Chemical Society;* **110**: No. 6, 1818-1827(16 Mar 1988).

Dinuclear, asymmetric, and dissymmetric μ-oxo complexes of technetium in which the two Tc atoms are in intimate electronic communication, have been synthesized and structurally characterized. The two types of complexes are isomers differing in their arrangement of equatorial ligands around each technetium, with the configurations being X_4 and (pyridine)$_4$ for the dissymmetric case and X_3(pyr) and (pyr)$_3$X for the asymmetric. A compound representative of the asymmetric complexes, [(Pic)Cl_3(Pic)Tc-O-TcCl(Pic)$_3$Cl] (III), crystallizes in the monoclinic space group $P2_1n$ with the following unit cell parameters: a = 12.421 A, b = 15,471 A, c = 18.764 A, β = 93.174°, and Z = 4. The geometry is essentially octahedral around each Tc, with the equatorial ligands on the opposite metal atoms being staggered relative to one another. Dissymmetric complexes of the type [X(L)$_4$Tc-O-TcX$_4$L], where X = Cl or Br and L = pyridine, 4-picoline, and 3,5 lutidine, are also formed by spontaneous self-assembly but are immediately derived from the asymmetric species. In the solid state, both types of compounds exhibit a small magnetic moment (μ/sub eff/ ~ 0.9-1.3 β). EPR spectra of the dissymmetric complex, [Cl(Pic)$_4$Tc-O-TcCl$_4$(Pic)] (I), whose structure has been previously reported, are consistent with an axial, binuclear species, containing splitting by two I = $^9/_2$ metal nuclei. Infrared Tc-O stretching frequencies are in the range 698-726 cm^{-1}, while Tc-Cl bands appear in the range 305-317 cm^{-1} and Tc-Br at at 235-266 cm^{-1}. Tissue distributions of these complexes in animals are reported and discussed.

37215 **[$(CH_3)_3C_5$]$_2$TH(CH_3)$_2$ surface chemistry and catalysis. Direct NMR spectroscopic observation of surface alkylation and ethylene insertion/polymerization on $MgCl_2$.** Hedden, D.; Marks, T.J. (Northwestern Univ., Evanston, IL (USA)). *Journal of the American Chemical Society;* **110**: No. 5, 1647-1649(2 Mar 1988). Contract FG02-86ER13511.

It is well-established that adsorption on inorganic surfaces can dramatically alter the reactivity of organometallic molecules; however, the structural chemistry of the resulting adsorbates is frequently ill-defined. From CPMAS NMR studies of Cp'$_2$Th(CH_3)$_2$ (Cp' = eta^5-(CH_3)$_5C_5$) on dehydroxylated γ-alumina (DA), they inferred the transfer of methyl groups to DA surface Lewis acid sites and the formation of less saturated Cp'$_2$Th(CH_3)$^+$ species with cationic character. Although model studies in solution support much of this chemical/spectroscopic hypothesis, the small percentage (≦ 4%) of Cp'$_2$Th(CH_3)$_2$/DA sites highly active for olefin hydrogenation and polymerization renders the connection with catalysis necessarily indirect. Complementary studies with high surface area $MgCl_2$, the preferred support for third generation Ziegler-Natta catalysis, are reported which provide the first evidence for the catalytic importance of methylmethide transfer on $MgCl_2$ and the first direct spectroscopic observation of the ethylene insertion/polymerization process on a supported catalyst.

37216 **Metal, bond energy, and ancillary ligand effects on actinide-carbon σ-bond hydrogenolysis. A kinetic and mechanistic study.** Lin, Z.; Marks, T.J. (Northwestern Univ., Evanston, IL (USA)). *Journal of the American Chemical Society;* **109**: No. 26, 7979-7985(23 Dec 1987). Contract AC02-81ER10980;FG02-86ER13511.

A kineticmechanistic study of actinide hydrocarbyl ligand hydrogenolysis (An-R + H_2 → An-H + RH) is reported. For the complex Cp'$_2$TH(CH_3-t-Bu)(O-t-Bu)(Cp' = eta^5-Me_5C_5), the rate law is first-order in organoactinide and first-order in H_2, with k/sub H2/k/sub D2/ = 2.5 (4) and k/sub THF/k/sub toluene/ = 2.9 (4). For a series of complexes, hydrogenolysis rates span a range of ca. 10^5 with Cp'$_2$ThCH$_2$C(CH_3)$_2$CH$_3$ ≈ Cp'$_2$U(CH_2-t-Bu) (too rapid to measure accurately) > Cp'$_2$Th(CH_2-t-Bu)[OCH(t-Bu)$_2$] = Cp'$_2$Th(CH_2-t-Bu)(O-t-Bu) > Cp'$_2$Th(CH_2-t-Bu)(Cl) > $Me_2Si(Me_4C_5)_2$Th(n-Bu)$_2$ > Cp'$_2$Th(n-Bu)$_2$ ≈ Cp'$_2$ThMe$_2$ > Cp'$_2$Th(Me)(O_3SCF_3) > Cp'$_2$Th(n-Bu)[OCG(t-Bu)$_2$] ≈ Cp'$_2$Th(Me)[OSiMe$_2$(t-Bu)] > Cp'$_2$ZrMe$_2$ = Cp'$_2$Th(rho-$C_6H_4NMe_2$)(O-tu-Bu) > Cp'$_2$Th(Ph)(O-t-Bu) > Cp'$_2$U(Me)[OCH(t-Bu)$_2$] > Cp'$_2$Th(Me)[OCH(t-Bu)$_2$]. In the majority of cases, the rate law is cleanly first-order in organoactinide over 3 or more half-lives. However, for Cp'$_2$ThMe$_2$ → (Cp'$_2$ThH$_2$)$_2$, an intermediate is observe by NMR that is probably [Cp'$_2$Th(Me)(μ-H)]$_2$. For Cp'$_2$Th(Me)(O_3SCF_3), a follow-up reaction, which consumes Cp'$_2$TH(H)(O_3SCF_3) is detected. Variable-temperature kinetic studies yield $\Delta H^{\ddagger\ddagger}$ = 3.7 (2) kcalmol and ΔS double dagger = -50.8 (7) eu for Cp'$_2$Th(CH_3-t-Bu)(O-t-Bu) and ΔH double dagger = 9 (2) kcalmol and ΔS double dagger = -45 (5) eu for Cp'$_2$U(Me)[OCH(O-t-Bu)$_2$].

37217 **Iodine-129 Moessbauer study of actinide iodides.** Karraker, D.G. (E. I. du Pont de Nemours and Company, Aiken, SC (USA)). *Inorganic Chemistry;* **26**: No. 22, 3816-3818(4 Nov 1987). Contract AC09-76SR00001.

Iodine-129 Moessbauer spectra of four actinide iodides, ThI_4, UI_4, NpI_3, and PuI_3 have been studied. The ^{129}I Moessbauer spectra of the iodides all showed a single asymmetric resonance with inflections in the envelope. The inflections and asymmetry of the envelope were interpreted to indicate that the normal ^{129}I quadrupole splitting was too small to be resolved. No significant differences were noted for the Moessbauer parameters among the four iodides. However, unexpected differences were noted in the isomer shifts and quadrupole coupling constants for lanthanide iodides and actinide iodides. 16 references, 2 figures, 2 tables.

37218 **Crystal-field analysis of Bk^{4+}:CeF_4.** Jursich, G.M.; Carnall, W.T.; Goodman, G.L. (Argonne National Lab., IL (USA)). pp 3 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-31-109-ENG-38.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

CeF_4 is isostructural with UF_4 which, in turn, provides a good structural model for other tetrafluoro-actinides. This structure entails an 8-fold coordination with neighboring fluorine atoms arranged in a distorted square antiprism. There are two distinct low-symmetry actinide sites in this class of compounds which can make spectra interpretation difficult due to both the possible multiplicity of absorption lines from the two sites and the complexity of the computational fitting because of the low symmetry involved. One approach to this problem is to approximate the antiprismatic structure as a single D/sub 4d/ site symmetry. Recently they recorded low-temperature fluorescence and excitation spectra on Bk^{4+}:CeF_4 up to 27,500 cm^{-1}. They report the results of their fitting of this data within a higher symmetry single site approximation and, then, extend the analysis to the spectra of other tetrafluoro-actinides.

37219 **Studies on the hydrolysis and carbonate complexation of dioxoplutonium(V).** Bennett, D.A.; Nitsche, H.; Silva, R.J.; Hoffman, D.C. (Lawrence Berkeley Lab., CA (USA)). pp 4 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC03-76SF00098.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The pentavalent oxidation state of plutonium in aqueous solution is thermodynamically unstable with respect to disproportionation into the +4 and +6 oxidation states at low pH. Consequently, the solution chemistry on Pu(V) has not been extensively investigated. However, because of the pH dependence of the disproportionation reaction, Pu(V) can be a dominant species in near neutral solutions. Therefore, the hydrolysis and carbonate complexation constants are important parameters to measure. Absorption spectrophotometry is being used to measure the stability constants. The spectrophotometer utilized in these experiments has the unique advantage of fiber optics which add new capabilities to this technique.

37220 Solution chemistry of uranium in $POCl_3$ ($SnCl_4$). Blaha, S.L.; Anderson, C.J.; Choppin, G.R.; Pruett, D.J. (Florida State Univ., Tallahassee (USA)). pp 4 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Studies are being carried out with uranium in the nonaqueous solvent $POCl_3$ with 5 mole percent $SnCl_4$. This solvent has been studied as a solvent for liquid lasers, since it minimizes radiationless decay. Solutions of anhydrous U(IV) chloride in optically clear $POCl_3$ ($SnCl_4$) have been prepared and investigated by spectrophotometry. The spectra of the U(IV) varied with increasing concentrations of sodium acetate. The spectra were analyzed for formation of uranium (IV) acetate complexes. Comparison of the acetate complexation and the associated spectra with the analogous aqueous systems will be discussed. This research was supported through a contract with the Chemical Technology Division of the Oak Ridge National Laboratory.

37221 Dissociation kinetics of uranyl from humic acid. Clark, S.B.; Choppin, G.R. (Florida State Univ., Tallahassee (USA)). pp 4 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The rate of dissociation of uranyl from humic acid has been investigated using spectroscopic techniques. The multicomponent first-order dissociation was found to be dependent on contact time prior to dissociation, as well as on pH and temperature. As the predissociation time is increased up to 48 hours, the amount of uranyl dissociating by the slower pathways increases. After 48 hours, no change is observed in either the rates of these pathways or the percent of uranyl dissociating by each pathway. The overall rate of dissociation is inversely dependent on pH, but increases with temperature. The general dissociation rate equation, rate constants, and activation energies have been determined using a kinetic spectrum method. From these values, a model for the kinetics of uranyl-humic acid interaction has been developed.

37222 Reduction kinetics of the dioxouranium(VI) ion bound to synthetic polyelectrolytes in aqueous solutions. Meisel, D.; Sullivan, J.C.; Pippin, C.G.; Choppin, G.R. (Argonne National Lab., IL (USA)). pp 5 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-31-109-ENG-38.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The characterization of actinide ion interactions with naturally occurring polyelectrolytes (e.g., humic substances) is necessary for developing a satisfactory model of actinide behavior in ecosystems. Synthetic polyelectrolytes having only carboxylic acid functional groups can be used to assess the importance of these groups in humic substances. This study examines the reduction of the dioxouranium (VI) ion in the presence of poly (acrylic acid) and poly (maleic acid) using a viologen radical generated by pulse-radiolysis techniques. The observed rate parameters for dioxo-uranium (VI) reduction show unexpected results as a function of polyelectrolyte concentration, degree of neutralization, and contact time. These results along with a possible mechanistic interpretation are discussed.

37223 ^{238}U double beta decay experiment. Turkevich, A.L.; Cowan, G.A.; Lawrence, F.; Knight, S.; Economou, T.; Haxton, W.C. (Univ. of Chicago, IL (USA)). pp 7 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The double beta decay of ^{238}U to ^{236}Pu (Q = 1.146 MeV) is being studied by a radiochemical technique. In 1950 a lower limit of 6×10^{18} yr was set for the half life, but recently interest has been revived in this system. Theoretical estimates range from 2.2×10^{19} to 1.5×10^{20} yrs. However, such estimates have been too short in the few cases of other nuclides for which experimental results exist. The present experiment uses 13 Kg of depleted uranium in 150 liters of a carbonate solution at pH 7.3. The cupferron complex of plutonium is periodically extracted into 4 liters of chloroform and the latter is evaporated and ignited. The plutonium is purified using ion exchange columns, and the 5.49 MeV alphas of ^{238}Pu are measured in counters having backgrounds of $\sim$ 0.05 events per day in a region of $\sim$ 150 KeV. The overall efficiency of the process can be monitored by the recovery of ^{239}Pu produced by spontaneous fission (4.5 decays per day after 90 days' accumulation). A half life for double beta decay of ^{238}U of 10^{20} yrs will lead to 1.2 disintegrations of ^{238}Pu per day after 90 days' accumulation.

37224 Mass spectrometric measurement of $^{100}Mo \rightarrow {}^{100}Ru + 2\beta^- + 2anti\ nu$. Rundberg, R.S.; Wolfsberg, K.; Rokop, D.J.; Perrin, R.E.; Murrell, M.T.; Curtis, D.B.; Cowan, G.A.; Bryant, E.A.; Attrep, M. (Los Alamos National Lab., NM (USA)). pp 7 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The half-life for 0nu double beta decay depends on the neutrino mass, and among other things on nuclear structure effects. Limits on the half-life for 2nu double beta decay have been established which are considerably longer than expected. A recent theoretical treatment, which attempts to explain the suppression of the double beta decay rate by including the particle-particle component of the spin-isospin polarization force, predicts a relatively short half-life for ^{100}Mo. The half-life predicted using an interaction strength based on an analysis of EC/β^+ decay rates is within the limit of sensitivity of mass spectrometry for ruthenium extracted from 200 kg of sodium molybdate. This experiment will provide an experimental basis for the nuclear structure effect which is needed to calculate a neutrino mass from the 0nu half-life (to be measured in an independent experiment). Thus the chemical experiment complements the charged particle detector experiments underway. The talk will describe the proposed experiment to be performed at Los Alamos.

37225 Atomic mass identification of CF-252 fission fragments using an NE-102 thin film detector. Milosevich, Z.; Muga, M.L.; Burnsed, D.J.; Thompson, S.D.; Coldwell, R.L. (Univ. of Florida, Gainesville (USA)). pp 8 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract FG05-84ER40149.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The measurement of atomic number of low energy Cf-252 fission products using a three element thin film scintillation detector in conjunction with a residual energy solid state detector is described. Critical comparison of the separate spectra yielded by the three thin film elements is used to show both quantitative and qualitative consistency. Through the use of simple data handling techniques, increased resolution between peaks is easily obtained; the resultant spectrum for the distribution of both heavy and light fragments of Cf-252 is presented. The anticipated application of thin film scintillation techniques for event-by-event illucidation of decay schemes will also be discussed.

37226 Nuclear Bragg scattering of synchrotron radiation by $^{57}Fe_2O_3$: a novel method for monochromatization with $\Delta E/E = 10^{-12}$. Haustein, P.E.; Faigel, G.; Siddons, D.P.; Hastings, J.B.; Grover, J.R.; Remeika, J.P.; Cooper, A.S. (Brookhaven National Lab., Upon, NY (USA)). pp 8 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC02-76CH00016.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The monochromatization of white synchrotron radiation of kilovolt energies to bandwidths of 10^{-6} to 10^{-8} eV will open up new fields of research with important applications in diverse areas of chemistry, physics, and the material sciences. These will be based on the unique sensitivity and specificity of nuclear resonance techniques. Nuclear Bragg scattering of synchrotron radiation from enriched α-$^{57}Fe_2O_3$ has been observed at the BNL National Synchrotron Light Source for the first time without need for delayed coincidence techniques. Experimental details will be presented and applications of this new technique will be discussed. A particularly interesting one is the development of filtered synchrotron beams for excitation of Moessbauer nuclei for which there are no convenient radioactive progenitor nuclei available in nature.

37227 Sorption of radionuclides in tuff using groundwaters of various compositions. Knight, S.D.; Thomas, K.W. (Los Alamos National Lab., NM (USA)). pp 9 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

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Three natural and several synthetic groundwaters were used to investigate the sorptive properties of a few selected radionuclides on tuff. The natural groundwaters were pumped from wells in the Yucca Mountain area that is being considered by the Nevada Nuclear Waste Storage Investigations Project as a possible site for a nuclear waste repository. The synthetic groundwaters were prepared to identify which components had the greatest effect in changing the sorptive behavior of the radionuclides studied. The tuff samples had various mineralogic compositions which were characteristic of the Yucca Mountain area. The radionuclides selected for this study were ^{85}Sr, ^{137}Cs, ^{133}Ba, ^{152}Eu, and ^{113}Sn, all at low concentration levels ($<10^{-7}$ M). Observed changes in sorptive behavior with the different groundwaters were element-dependent, and within the concentration ranges studied, no single ionic species appeared to exert a controlling influence on the sorption of these radionuclides.

37228 Chemical aspects of the gallex solar neutrino experiment. Hahn, R.L. (Brookhaven National Lab., Upton, NY (USA)). pp 12 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC02-76CH00016.

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The Gallex solar neutrino experiment, described in the previous paper, will utilize 30 tons of gallium, in the form of an aqueous solution of 8M $GaCl_3$, as a radiochemical detector of solar neutrinos. The capture of a neutrino by ^{71}Ga will initiate inverse β decay and produce ^{71}Ge, which decays with an 11.2-day half-life. This talk will focus on the chemical steps that have been devised to separate the minute amounts of product germanium from the gallium solution and to convert the ^{71}Ge to a chemical form suitable for inclusion in a proportional counter. Questions concerning the specification and determination of impurity levels in the $GaCl_3$ solution, so as to preclude reactions on impurities that would mimic the capture of a solar neutrino by ^{71}Ga, will also be discussed.

37229 Search for the monovalent species, mendelevium 1^+. Payne, G.F.; Keller, O.L.; Halperin, J.; Wilmarth, W.R.; Peterson, J.R.; Lougheed, R.W.; Silva, R.J.; Hulet, E.K. (Oak Ridge National Lab., TN (USA)). pp 17-18 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC05-84OR21400.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The claimed production by Mikheev of Md^{1+} in aqueousalcoholic solutions has not been confirmed by others. The authors are taking a new approach using aprotic solvents. If Mikheev's work is correct, Md^{2+} should be attainable by Zn reduction in such solvents. If Mikheev's work is correct, Md^{1+} should be attainable by Zn reduction in such solvents. If not it should be reduced to Md^{3+}. The oxidation state determination will be made by ion exchange techniques. They have shown the log K/sub d/ for Cs^{1+} tracer vs log Na^{1+} concentration gives a slope of -1 in a solution of benzonitrile containing $NaClO_4$ as supporting electrolyte. Similarly they have obtained a slope of -1 for Eu^{2+} (after reduction from Eu^{3+}) and Sr^{2+} tracers vs log Ba^{2+} with $BaClO_4$ as supporting electrolyte. Thus the reduction of Md^{3+} to Md^{1+} can be established by exchanging against Na^{1+} as supporting electrolyte and the reduction to Md^{2+} by exchanging against Ba^{2+} (using Amberlyst 15 or Nafion 117 resins). Results of the mendelevium experiments are presented.

37230 Non-eka-tantalum behavior in Ha (element 105). Gregorich, K.E.; Henderson, R.A.; Bennett, D.A.; Chadwick, R.B.; Chasteler, R.M.; Gannett, C.M.; Hall, H.L.; Lee, D.; Leyba, J.D.; Nurmia, M.J.; Seaborg, G.T. (Univ. of California, Berkeley (USA)). pp 18 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC03-76SF00098.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The authors have attempted a chemical identification of 35-s ^{262}Ha by extraction of the HaF_7^{2-} complex into methyl isobutyl ketone. ^{262}Ha was produced by the $^{249}Bk(^{18}O,5n)^{262}Ha$ reaction at an ^{18}O energy of 101 MeV. The total processing time, from end of bombardment to the start of counting for alpha and SF decays of ^{262}Ha, averaged 50 s. The procedure was tested using ^{173}Ta produced by the $^{159}Tb(^{18}O,5n)^{173}Ta$ reaction, and with ^{182}Ta tracer. In 335 individual experiments, no Sf events or alpha decays of ^{262}Ha or its daughter, ^{258}Lr, were detected. Based on published production cross sections and alpha/SF branching ratios, and on their own measurements, they estimate that they should have seen 27 fissions and 6 alphas. It appears that the F^- complexation of Ha is different from that of its lighter homolog, Ta, possibly due to the stabilization of lower oxidation states in Ha such as Ha^{3+} with the configuration $[Rn]7s^25f^{14}$.

37231 Spectroscopic and photophysical opportunities and challenges in laser excitation studies of transplutonium species in solution. Beitz, J.V. (Argonne National Lab., IL (USA)). pp 20-21 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Laser excitation of transplutonium (TPU) ions can populate the electronic states most characteristic of actinide ions which are 5f electron states. This method affords unique opportunities to establish 5f state energy level structure, transition intensities and photodynamics of aquo and complexed TPU ions in solution. For instance, laser-induced fluorescence studies of 5f states of Am^{3+}, Cm^{3+}, Bk^{3+} and Es^{3+} as aquo ions have resulted in the first systematic and predictive understanding of TPU ion non-radiative decay in aqueous solution and have provided evidence concerning innersphere coordination of water when Am^{3+} is extracted from an

aqueous solution into an organic phase. The demonstrated high sensitivity of laser excitation techniques, including photoacoustic and thermal lensing methods, have created opportunities to study TPU ion speciation and complexation at concentrations typical of those expected in near-neutral pH solutions or in aqueous and organic process streams. Examples of the current application of laser excitation techniques to TPU ions in solution and future research opportunities will be presented.

37232 **Berkelium chemistry in complexing aqueous solutions and in the solid state.** Hobart, D.E.; Morris, D.E.; Palmer, P.D.; Haire, R.G.; Peterson, J.R. (Los Alamos National Lab., NM (USA)). pp 21 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-7405-ENG-36;AS05-76ER04447;AC05-84OR21400.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Although the chemistry of berkelium is reasonably well known in mineral acid solutions, there is a lack of extensive knowledge of the behavior of this element in complexing aqueous media. Furthermore, the list of known compounds of Bk(III) and Bk(IV) is relatively short when compared to that of neighboring actinides. Multimilligram quantities of Bk-249 ($t_{1/2}$ = 320 days; 0.125 MeV β^- decay) were studied in aqueous carbonate and citrate solutions via absorption spectroscopy and bulk solution electrolysis. The spectra of Bk(III) in carbonate and citrate media are reported for the first time. New Bk solids have been prepared and a more complete characterization of $Bk_2(C_2O_4)_3$ has been made.

37233 **Carbonate complexation of Am(III) in aqueous solution.** Nitsche, H.; Silva, R.J. (Univ. of California, Berkeley (USA)). pp 21 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Solubility limits are being used to assess the performance of potential high-level nuclear waste repositories. Speciation and solubilities of the radionuclides are predicted by geochemical modeling. Americium is a major contributor for the radioactivity of the waste after several hundred years. Since carbonate is common to most groundwaters, reliable thermodynamic data are required as input for the models. Data exist in the literature on proposed carbonate, bicarbonate hydroxycarbonate solution species of Am^{3+}. Modeling calculations indicate that these data are not internally consistent. The Am carbonate and hydroxide systems are being investigated via absorption spectroscopy. Results will be analyzed with a modeling code to determine the relevancy of the proposed species and their formation constants.

37234 **Voltammetric investigations of the Bk(IV/III) and Ce(IV/III) redox couples in concentrated aqueous carbonate solutions.** Morris, D.E.; Hobart, D.E.; Palmer, P.D.; Haire, R.G.; Peterson, J.R. (Los Alamos National Lab., NM (USA)). pp 21 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-7405-ENG-36;AS05-76ER04447;AC05-84OR21400.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Concentrated solutions of strongly complexing anions, such as CO_3^{2-}, greatly stabilize the 4+ oxidation state of Bk and Ce. The Bk(IV/III) ($E^{0'}$ similarly ordered 0.2 V/NHE) and Ce(IV/III) (similarly ordered 0.0 V/NHE) couples in carbonate media occur in a potential region which is convenient for cyclic voltammetric investigation. A detailed investigation has been carried out for these two couples as a function of [CO_3^{2-}] (2-5 M) and pH (~ 9-14). Variations in half-wave potentials and electrochemical reversibility are observed over this range of solution conditions. Adsorptive interactions and direct electrochemical evidence for a chemical reaction accompanying reduction are also observed. These results will be discussed and a comparison between the behavior of the two couples will be drawn.

37235 **Recent studies of transplutonium compounds: new directions and use of extreme conditions.** Peterson, J.R.; Begun, G.M.; Gibson, J.K.; Haire, R.G.; Hart, R.C.; Moore, J.R.; Nave, S.E.; Payne, G.F.; Thevenin, T.L.; Wilmarth, W.R.; Young, J.P. (Univ. of Tennessee, Knoxville (USA)). pp 25 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AS05-76ER04447;AC05-84OR21400.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The number of bulk-phase compounds prepared and characterized for each of the transplutonium (TPu) elements drops off precipitously with increasing atomic number. However, efforts have been made to increase the number of TPu compounds known and also the range of investigative methods applied to their characterization. The results of a worldwide survey to determine the status of the preparation of new TPu compounds and/or the application of new investigative techniques to the study of such compounds in bulk will be presented. The focus will then shift to Oak Ridge projects: extreme conditions of pressure and/or temperature are being used for synthesis and for absorption and raman spectral studies; single crystals of trihalides are being grown for spectral and magnetic studies; new ternary chalcogenide-halide compounds are being characterized; vaporization thermodynamics of TPu compounds are being determined; and attempts to stabilize unusual oxidation states are being carried out.

37236 **High-temperature vapor pressure studies of the transplutonium elements.** Haire, R.G.; Gibson, J.K. (Oak Ridge National Lab., TN (USA)). pp 25 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC05-84OR21400.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Measuring the enthalpy of sublimation for the actinide metals is one technique that has been used to provide information about their cohesive energy and the changing nature of the bonding in the series. These enthalpies have been acquired previously for many of the actinide elements through Es. In several cases experimental techniques had to be adjusted to cope with limited quantities of material and relatively short half-lives. They will report on recent sublimation studies that have been carried out using alloys of selected transplutonium elements through Fm and will discuss their results in conjunction with relevant information that has been reported for the actinide elements.

37237 **Effect of pressure on Am-Cm alloys.** Haire, R.G.; Dabos, S.; Benedict, U.; Dufour, C. (Oak Ridge National Lab., TN (USA)). pp 25 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC05-84OR21400.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

X-ray diffraction studies of the transplutonium metals under high pressure have shown that pressure can force the metal's 5f electrons to participate in bonding (become delocalized) in addition to inducing structural transformations. It has been shown that the pressures required to bring about these changes depend on the particular actinide that is being studied. They have recently studied alloys of Am and Cm under pressures up to 55 GPa in order to define their behaviors under pressure. They shall report the results of these studies and compare them with data for pure Am and Cm metals under pressure.

37238 **New ternary transplutonium compounds: chalcogenide halides.** Thevenin, T.L.; Wilmarth, W.R.; Peterson, J.R.; Haire, R.G. (Univ. of Tennessee, Knoxville (USA)). pp 26 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AS05-76ER04447;AC05-84OR21400.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Although chalcogenide halides have been identified in almost all groups of the Periodic Table, they were previously unknown in the case of the actinide elements. Based on the known lanthanide chalcogenide halides, they focused their investigation on the sulfur-based compounds. Consistent with the scarcity of transplutonium elements, they developed an original microscale preparation of the ternary compounds AnSI (An = ^{242}Pu, ^{243}Am, ^{248}Cm). The reaction scheme is: An_2O_3 (or AnO_2) → $AnBr_3$ →AnI_3 → AnSI. All products are examined by X-ray powder diffraction and solid state spectroscopy.

37239 **Spectrophotometric study of thermally induced structural transformations of $CfCl_3$.** Young, J.P.; Peterson, J.R.; Haire, R.G. (Oak Ridge National Lab., TN (USA)). pp 26 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AS05-76ER04447;AC05-84OR21400.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Californium trichloride is known to exist in either of two crystallographic forms, $PuBr_3$-type orthorhombic or UCl_3-type hexagonal. It has been known for some time that either form can be transformed to the other by thermal treatment. The orthorhombic form can be prepared by quenching a melted sample of $CfCl_3$. The method for complete conversion of the orthorhombic form to the hexagonal form has been less clear. They have made absorption spectral measurements of $CfCl_3$ at various temperatures and under various conditions up to and beyond its melting point, 545°C, in order to develop a set of controlled conditions for the structural transformations. The furnace for doing these studies will be described, and detailed results of the thermal study will be discussed. Possible mechanisms by which the transformations are accomplished will also be presented.

37240 **Studies of the thermal stability of americium and curium tetrafluorides.** Gibson, J.K.; Haire, R.G. (Oak Ridge National Lab., TN (USA)). pp 26 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC05-84OR21400.

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The relative stabilities of an element's oxidation states in various environments are of fundamental interest. The fluorides are convenient compounds for probing the various oxidation states of the transplutonium elements and measurement of the thermal decomposition of their tetrafluorides to trifluorides provides such information. They have studied the reaction: $MF_4(s) \rightarrow MF_3(s) + 1/2\ F_2\ (g)$ for M = Am and Cm (as well as the lanthanides, Ce and Tb) by mass spectrometrically monitoring the fluorine evolution from the tetrafluorides as a function of temperature. From these measurements, the enthalpies associated with the decomposition reactions have been derived. The results of their investigations will be reported and compared with previous experimental data and predictions for the thermal behavior of these materials.

37241 **New results from nuclear studies of the heaviest actinides.** Lougheed, R.W.; Hulet, E.K.; Wild, J.F.; Moody, K.J.; Dougan, R.J. (Lawrence Livermore National Lab., CA (USA)). pp 29 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-7405-ENG-48.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Heavy ion bombardments of ^{254}Es have produced abundant experimental results in the past several years. These results include the discovery of bimodal fission in the neutron-rich Fm and Md isotopes, the discovery of several new isotopes, improved knowledge of the decay properties of the heavy actinides, and even information on the chemical behavior of lawrencium. They will present information on the decay properties of the new isotopes ^{260}Md (31.8-d half-life), ^{261}Lr (39-m half-life) and ^{262}Lr (216-m half-life). The observed spontaneous fission activity associated with ^{262}Lr is most likely from its decay daughter, ^{262}No, which would be the first isotope with N = 160. The relatively long half-lives for these neutron-rich nuclides and their production rates from ^{254}Es targets make it possible to study their spontaneous fission properties in detail and indicate that new longer-lived isotopes may be discovered near the predicted 162 neutron shell at Z = 104 to 110.

37242 **Neutron emission from the spontaneous fission of ^{260}Md.** Wild, J.F.; Lougheed, R.W.; Moody, K.J.; Dougan, R.J.; Hulet, E.K.; Aarle, J.V.; Westmeier, W.; Brandt, R.; Patzelt, P. (Lawrence Livermore National Lab., CA (USA)). pp 30 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washihington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-7405-ENG-48.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The authors have measured the multiplicity of prompt neutrons emitted in the bimodal spontaneous fission of 32-d Md-260. The corrected neutron distribution appears also to be bimodal, with averages of about 1.4 neutrons/fission for one group, and about 4.3 neutrons/fission for the other group, as determined by fitting Gaussian curves to the total distribution. The number of events in each neutron distribution corresponds well to the proportion of fission events previously determined for the fragment energy groups with most probable total kinetic energies (TKE) of 235 MeV and 195 MeV, respectively. This, and a rough measurement of the average TKE as a function of neutron multiplicity, supports their supposition that the high-energy events arise from a compact scission configuration of nearly spherical fragments with little deformation energy available for post-scission deexcitation.

37243 **Calculated fission properties of the heaviest elements.** Moeller, P.; Nix, J.R. (Los Alamos National Lab., NM (USA)). pp 30 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Experimental results that have been obtained over the past 15 years on fission properties of nuclei in the vicinity of ^{256}Fm show rapid variations with a change of only a few nucleon numbers. For example, the fission half-lives may change by 10 orders of magnitude, the mass division may change from asymmetric to symmetric, and the peak in the kinetic-energy distribution may shift by 40 MeV. It has been suggested that this behavior is due to the emergence of a new fission valley leading to compact scission shapes. They study the fission properties in this region by use of a macroscopic-microscopic method. They discuss some model features that are required for a quantitative calculation of the potential energy for compact scission shapes. Two such features are: (1) a shape parameterization that allows for the generation of the two-touching sphere configuration and (2) a macroscopic model that takes into account the nuclear interaction energy for shapes close to

two touching spheres. The nuclear potential energy is calculated from ground-state configurations to compact and elongated scission shapes. They present color topographical maps of the potential energy as a function of shape. The calculated maps give them a quantitative understanding of the observed fission half-lives and a qualitative understanding of the fission-fragment kinetic energies and mass distributions and their interdependence.

37244 **Cross sections for production of above target nuclides from O-18 with Bk-249.** Gannett, C.M.; Bennett, D.A.; Chadwick, R.B.; Chasteler, R.M.; Gregorich, K.E.; Hall, H.L.; Henderson, R.; Lee, D.M.; Leyba, J.; Nurmia, M.; Hoffman, D.C. (Lawrence Berkeley Lab., CA (USA)). pp 35 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC03-76SF00098.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Cross sections for production of Cf, Es, Fm and Md were measured for reactions of 102 and 109 MeV O-18 projectiles with Bk-249 targets. Yields for No and Lr were also determined at 102 MeV. The mass-yield distributions are similar in shape to those for O-18 plus Cm-249, Cf-249, Es-254, except that the He transfer have a smaller half-width. The highest yield for each type of transfer to the Bk target is greater than that for the other targets. Also, the yields for H and He transfers to the Bk target differ by an order of magnitude while they are nearly the same for the other targets.

37245 **β-delayed fission from ^{256}Es and the level scheme of ^{256}FM.** Hall, H.L.; Henderson, R.A.; Gregorich, K.E.; Hoffman, D.C.; Lee, D.M.; Wilhelmy, J.B.; Bunker, M.E.; Starner, J.W.; Fowler, M.M. (Lawrence Berkeley Lab., CA (USA)). pp 36 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

A 0.1 μg target of ^{254}Es was bombarded with tritium, forming /sup 256m/Es by the (t,p) reaction. The reaction products were separated radiochemically, and then the β-decay of /sup 256m/Es to levels about 1.5 MeV above the ground state in the daughter ^{256}Fm and subsequent γ-decays were followed using correlation techniques. From these measurements, they are able to present a more complete level scheme for ^{256}Fm, as well as report that two delayed-fission events were observed. A B-delayed fission probability of 2×10^{-5} relative to total decay was obtained, and the fission half-life of the excited state was determined to be 0.8 ms with a 95% confidence level range of 0.11 ms to 9.6 ms.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 35611, 36595, 38149, 39042

37246 **(CONF-860804—15) Numerical simulation of flame propagation in constant volume chambers.** Ghoniem, A.F.; Knio, O.M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). Jul 1986. Contract AC04-81AL16310. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009466/JAW.

From 21. international symposium on combustion; Munich, F.R. Germany (3 Aug 1986).

Combustion of premixed gases inside a closed chamber is computed using a thin flame model at high Damkohler number. The burning velocity is taken as a function of the thermodynamics of the reacting mixture and the flame front curvature. Gas motion due to expansion across the flame is computed assuming an inviscid flow at low Mach number. Results show that the flame is unstable, developing wrinkles which grow into deep indentation along the front. A stabilizing mechanism associated with curvature damps small scales and moderates the rate of growth of perturbations. However, long wavelength perturbations survive and affect the later stages of burning. Numerical results are compared with experimental data on flame propagation in a quiescent mixture inside a circular chamber, initiated by central or side ignition sources. Using recent measurement of the Markstein length, good agreement is obtained for the first case. Some deviation is seen in the second case due to heat losses when the flame propagates close to the chamber walls. The model is applied to study the effect of swirl on the rate of burning and pressure rise. 22 refs., 6 figs.

37247 **(CONF-860808—16) Explosions of adiabatically compressed gases in a constant volume bomb.** Keck, J.C.; Hu, H. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1986. Contract AC04-81AL16310. 26p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009465/JAW.

From 7. international congress on photosynthesis; Providence, RI, USA (10 Aug 1986).

Measurements of the explosion limits for fuel-air mixtures compressed by an expanding laminar flame front have been made in a constant volume bomb. The mixtures studied to date include normal pentane, hexane and heptane with fuel-air equivalence ratios in the range 0.8 to 1.3. An Arrhenius plot of the explosion density as a function of reciprocal temperature in the range 670 to 720{degree}K is consistent with an activation energy of 51 kcal/mole. For fixed initial temperature and pressure, the explosion density has weak minimum at an equivalence ratio near {phi}=1.1 and decreases with increasing chain length. This behavior is in good agreement with observations made in rapid compression machines and spark ignition engines. A simple kinetic model based on a branched chain mechanism has been developed to correlate the data. In the first stage region the equations are linear and can be integrated approximately using the WKB method. The resulting expression gives an explicit connection between the explosion limit for gases undergoing adiabatic compression and the first stage induction time at constant density. Quantitative agreement between theory and experiment can be achieved with minor modifications in values of published rate constants. 29 refs., 7 figs., 1 tab.

37248 **(DOE/ER/10677—8) Diffusion flame studies of the chemical and physical mechanisms of soot formation from aromatic and substituted aromatic fuels: Final report for the period February 16, 1984-February 15, 1988.** Merklin, J.F.; Sorensen, C.M. (Kansas State Univ., Manhattan (USA)). Mar 1988. 52p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008231/JAW.

Benzene was found to be the first product formed in the shock-tube pyrolysis of toluene in the temperature range from 1100 to 1700{degree}K. The yield of benzene peaked at 1425{degree}K. The production of benzene, acetylene and methane were modelled by a set of nine chemical reactions, using rate constants reported in the literature. Benzene was shock-heated in the temperature range from 1100 to 1700{degree}K and biphenyl, phenanthrene, pyrene and p-terphenyl were detected with the liner residue method. This is the first time these species have been observed in shock-tube pyrolysis. These results suggest that in the initial stages of soot formation phenyl rings and acetylenic fragments are required. From the chemical probing of a sooting pre-mixed methane oxygen, it is shown that the growth of soot particles is largely due to surface addition of acetylenic fragments. Premixed methane/oxygen flames and benzene-doped methane/oxygen flames were optically probed to determine the soot volume fraction and the soot particle size. The maximum flame temperature and C/O were held constant. As the benzene concentration was increased, the soot volume fraction increased at early times in the flames. However, the ultimate soot volume fraction was unaffected by the substitution of benzene for methane. 21 refs., 21 figs., 6 tabs.

37249 **(DOE/ER/13269—T3) A program to study CH reactions relevant to combustion/gasification processes: Final report, July 1986-July 1987.** Anderson, S.M.; Freedman, A.; Kolb, C.E. (Aerodyne Research, Inc., Billerica, MA (USA). Center for Chemical and Environmental Physics). Jan 1988. Contract FG02-84ER13269. 24p. (ARI-RR—619). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008095/JAW.

In the first year of our present program, we investigated a chemical CW source of carbyne radicals suitable for kinetic studies

in fast-flow reactors. The approach used alkali metal atoms (M = Na or K) to successively abstract halogen (X = Br or C{ell}) atoms from a haloform molecule, producing the CH radical and three alkali halide molecules. Early in the second year, attempts to observe CH reacting with O_2, H_2, and N_2 produced mixed results, suggesting that better separation between CH production and reaction zones was necessary. A pre-reactor assembly that permits variation of nearly all source parameters independent of main reactor conditions was constructed. The third year of the program yielded high-quality kinetic data for five CH reactions (CH + Cl_2, N_2O, CH_4, O_2, and H_2), and preliminary results for three others (D_2, NO and N_2) at 2 Torr and 290{degree}K. This was the first study of the CH + Cl_2 reaction. In addition, we made preliminary observations of significant OH production from both the CH + O_2 and NO reactions. Initial attempts to operate at higher temperatures (up to 1100 K) revealed a needed design change in the source. Plans for the fourth year of this effort include completing a study of CH + N_2, H_2 and CO reaction kinetics, as a function of temperature, determining the OH yields for CH + O_2 and NO, and investigating mechanistically related reactions, such as $^{13}CH + {}^{13}CO \rightarrow {}^{13}CH + {}^{13}CO$. 20 refs., 8 figs.

37250 (DOE/ER/13282—5) Aromatics oxidation and soot formation in flames: Progress report for year beginning 15 August 1987. Howard, J.B. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 1987. Contract FG02-84ER13282. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010960/JAW.

Work during this period has been concerned with further analysis of the high molecular weight compounds found in the soot inception zone of flames and assessment of the role these species may play in the nucleation of nascent soot particles. The number concentration of these species had been found to exhibit a maximum near the zone of soot nucleation. The extent to which the mass concentration of these heavy species changes during soot inception had not been established beyond doubt, and the possible conversion of mass from heavy molecules to nascent soot particles, including the presumed competition between destruction and growth, required clarification. To these ends, probe samples were collected and analyzed and the data were interpreted. 6 refs., 3 figs., 1 tab.

37251 (SAND—88-0553C) Development of an experimental system for studying fast transient ignition phenomena. Skocypec, R.D.; Erickson, K.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880750—11). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011917/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

This paper describes work in progress to develop an experimental system for studying fast transient ignition phenomena. The system integrates several diagnostic techniques to study the fast transient reaction kinetics (~ 10 μs temporal resolution) governing the thermal ignition of pyrotechnics and explosives. The principal components of the system include: (1) a time-of-flight (TOF) mass spectrometer and a quadrupole mass spectrometer, (2) a photo-elastic modulator (PEM) ellipsometer, (3) a pulsed dye laser and a continuous wave ND:YAG laser, (4) an infrared detector array, (5) ultra-high vacuum systems, and (6) a high-speed, computer-based data acquisition system. The basic experimental concept is to react samples having a simple, known geometry for which complex heat and mass transfer effects are minimized so that reaction mechanisms and rates can be examined directly.

37252 (SAND—88-8217) Summary of discussions at the tenth meeting of the Sandia Cooperative Group on the Aerothermochemistry of Turbulent Combustion. Dibble, R.W.; Lucht, R.P. (Sandia National Labs., Livermore, CA (USA)). Mar 1988. Contract AC04-76DR00789. 26p. (CONF-8710304—Summs.). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008467/JAW.

From 10. meeting of the Sandia cooperative group on the aerothermochemistry of turbulent combustion; Warren, MI, USA (12 Oct 1987).

A turbulent reacting flow working group has been established through the sponsorship of the Department of Energy, Office of Basic Energy Sciences, Division of Chemical Sciences. Purpose of this group is to establish and maintain a strong interaction and active dialogue between workers currently involved in modeling turbulent reacting flows and those involved in related experiments. One objective of this collaboration is to develop an increased understanding of the fundamental interaction between the chemical and fluid dynamical processes occurring in chemically reacting flows and to utilize this understanding to improve predictive capabilities for turbulent combustion. Regular members, who represent academia, private industry, and national laboratories, and guests participate in the meetings. Several guests are invited to each meeting to provide an influx of different ideas and opinions to the discussions. This document is a summary of the discussions that took place during the tenth meeting, which was held at General Motors Research Laboratories, Warren, Michigan, October 12-13, 1987.

37253 (STEV-FBT—87-34) Practical and theoretical study of sintering of coal ash and limestone in a fluidized bed combustor. Steenari, B.M. (Statens Energiverk, Stockholm (Sweden)). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752950/JAW.

Conditions critical for sintering of the bed material in FBC boilers were investigated experimentally and theoretically. Potassium lowers the melting temperature in the $CaO-SiO_2-Al_2O_3$ system. This is especially important when fuels rich in alkalies like wood are used. Another critical situation is when reducing conditions are used in the bed. $CaSO_4$ is then reduced to CaS and the resultant sulfate - sulfide mixture has an eutectic region at 830 - 1200 degrees C depending on which other elements are present. Initial results from calculations using a thermodynamic model on the system $CaO-SiO_2-Al_2O_3-K_2O$ are also reported. The liquidus temperatures obtained from such calculations do not agree very well with experimental ones. However, relative trends like the effect of additives on a specific ash composition may be evaluated by the thermodynamic model.

37254 (STEV-FBT—87-35) Theoretical studies of processes essential for sintering and slagging in combustion plants. Progress report 1. $Al_2O_3-CaO-K_2O-SiO_2$ system. Idrestedt, I.; Lindqvist, O.; Steenari, B.M. (Statens Energiverk, Stockholm (Sweden)). Jan 1987. 56p. (In Swedish). (CTH-OOK—87-01). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752951/JAW.

The report includes a literature survey and a description of experimental methods for the determination of thermodynamic data and phase diagrams. A number of theoretical models for the calculation of phase diagrams and activity data are presented. Some preliminary tests of computerized models have been performed. 56 refs. (G.B.).

37255 (STEV-FBT—87-38) Temperature measurement on the surface of the particle. Gromulski, J. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). Feb 1987. 21p. (In Swedish). (STUDSVIK-EP—87-10). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752952/JAW.

This report describes the experiments carried out in a drop tube furnace with a Polish coal, with the aim of measuring the surface temperature of individual fuel particles. A two wave pyrometer with a response time of 8 msec was used to measure the temperatures. This technique was compared with conventional methods such as thermocouple, suction pyrometer and hot wire anemometer. The results obtained show that the particle temperature is greater than the gas temperature. The measured values agreed quantitatively with those theoretically calculated from a simple mathematical model based on the combustion of a fraction of the particles. The instrument can be used over a wide range, from the particle concentrations existing in the drop tube furnace to those conditions found in real pulverized flames.

37256 (UCRL—98402) The oxidation of N-butane at low and intermediate temperatures: An experimental and modeling study. Pitz, W.J.; Wilk, R.D.; Westbrook, C.K.; Cernansky, N.P. (Lawrence Livermore National Lab., CA (USA); Drexel Univ., Philadelphia, PA (USA). Dept. of Mechanical Engineering and Mechanics). 10 Mar 1988. Contract W-7405-ENG-48. 38p. (CONF-880373—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008039/JAW.

From Western States Section/The Combustion Institute spring meeting; Salt Lake City, UT, USA (21 Mar 1988).

An experimental and modeling study of n-butane oxidation in a static reactor was conducted at temperatures encompassing the negative temperature coefficient region and portions of the low and intermediate temperature regimes. The numerical model employed a detailed chemical kinetic mechanism for n-butane oxidation. Conditions considered in the combined study were temperatures in the range of 554-737 K, an initial pressure of 550 torr, and a molar mixture ratio of 1:20:20.33 n-butane:O_2:N_2. The induction period and stable species concentrations were measured and comapred to modeling predictions. The variation in induction period over the region of negative temperature coefficient is well-predicted by the model. The model is also used to analyze the static reactor data of Baker who investigated n-butane$H_2O_2N_2$ mixtures. The agreement between their detailed species concentration measurements and the modeling predictions is good. Modeling calculations identified some of the key reactions at the conditions investigated. Internal H-atom abstractions of the butyl peroxy radicals and subsequent reactions contributed significantly to the major intermediate species that were observed and to the production of reactive OH radicals. Additionally, radical-radical reactions involving the HO_2 radical consumed a significant amount of butyl peroxy radicals and accelerated the overall rate of oxidation. 53 refs., 5 figs., 1 tab.

37257 Calculation of saturation line shapes and intensities in coherent anti-Stokes Raman scattering spectra of nitrogen. Lucht, R.P.; Farrow, R.L. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 6, 1243-1252(Jun 1988).

Line shapes and intensities for coherent anti-Stokes Raman scattering (CARS) at saturation laser intensities are determined for nitrogen vibrational Q-branch lines by solving the time-dependent density-matrix equations numerically. We have previously performed measurements of saturated CARS line shapes in pure nitrogen by using nearly Fourier-transform-limited pump and Stokes lasers. The experimental laser pulse shapes, Stark effects, Doppler broadening, and the nonresonant background are incorporated in the numerical calculations. The numerical results show good agreement with the high-resolution measurements of saturated CARS line shapes. The lines show prominent saturation dips, and agreement between theory and experiment is excellent in terms of the depth and the width of the dips. The numerical results indicate that the Doppler effect tends to broaden and to deepen the dip in highly saturated lines, an effect that cannot be explained by a steady-state theory.

37258 Factors affecting gas-phase continuous wave infrared laser sensitized pyrolysis. Zhu, J.; Yeung, E.S. (Iowa State Univ., Ames (USA)). *Journal of Physical Chemistry;* 92: No. 8, 2184-2188(21 Apr 1988). Contract W-7405-ENG-82.

A model is developed for predicting temperature profiles in a gas cell containing an absorbing gas when irradiated by a CW laser beam with well-defined parameters. The model takes into account the explicit temperature dependence of heat capacities, thermal conductivities, molar absorptivities, and gas densities. The predicted transmittance of the laser beam as a function of incident power agrees with experimental values. The model is further used to predict rate parameters of a standard homogeneous pyrolysis reaction that is sensitized by the heated gas. The results provide insight into the comparison between the traditional thermal processes and CW laser sensitized pyrolysis.

37259 Chemical Kinetic Data Base for Combustion Chemistry. Part 3: Propane. Wing Tsang. (Chemical Kinetics Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Physical and Chemical Reference Data;* 17: No. 2, 887-951(Apr 1988).

This publication contains evaluated and estimated data on the kinetics of reactions involving propane, isopropyl radical, n-propyl radical, and various small inorganic and organic species which are of importance for proper understanding of propane pyrolysis and combustion. It is meant to be used in conjunction with the kinetic data given in earlier publications which are of direct pertinence to the understanding of methane pyrolysis and combustion, but which also contain a large volume of data that are applicable to the propane system. The temperature range covered is 300—2500 K and the density range 1 x 10^{16} to 1 x 10^{21} molecules cm^{-3}.

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REFER ALSO TO CITATION(S) 37788

37260 (GEPP-TIS—366e) A bibliography and author index for electrical discharges in vacuum (1897-1986). Miller, H.C. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). Mar 1988. Contract AC04-76DP00656. 395p. NTIS, PC A17/MF A01;1; GPO Dep. Order Number DE88008744/JAW.

This bibliography covers the field of electrical discharges in vacuum, comprising both electrical breakdown in vacuum and vacuum arcs. A brief reference review section lists some papers which would be helpful to the novice in this field. The bulk of this paper consists of bioliographic listings, arranged by year of publication and alphatectically by first author within each year. An author index refers one to all papers authored or coauthored by a particular person. There are 3483 papers listed through December 1986.

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REFER ALSO TO CITATION(S) 35620, 35655, 35735, 35744, 35835, 35836, 35859, 35984, 36044, 36145, 36225, 36321, 36455, 36465, 36632, 36782, 36857, 36871, 36883, 36890, 37384, 37570, 37610, 37620, 37627, 37628, 37631, 37718, 38013, 38143, 38914, 38983, 38995

37261 (AD-A—190449/9/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 4, Fort Worth, Texas. Volume 9. Appendices F-K. Final report, September 1985-September 1986. (Radian Corp., Austin, TX (USA)). Dec 1987. 371p. NTIS, PC A16/MF A01.

Includes envelope with map. See also Volume 10, AD-A190 450.

This report discusses analytical data concerning water quality and environmental protection. This report was prepared for the United States Air Force by Radian Corporation, for the purpose of aiding in the implementation of the Air Force Installation Restoration Program.

37262 (AD-A—190661/9/XAB) Technique for code augmentation. Memorandum report. Fickie, K.D.; Grosh, J. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Oct 1987. 40p. (BRL-MR—3622). NTIS, PC A03/MF A01.

A simple method for calling pre-existing computer codes from inside another program is described. Three applications drawn from the field of interior ballistics are included as examples. Two of the cases are optimization problems and the other is a simple search for a constraint condition. More elaborate applications in the area of computer-aided design are discussed.

37263 (AD-A—190666/8/XAB) Superconducting phase shifter in the development of a Terahertz Imaging Radar System. Final technical report, August 1985-January 1987. Baliga, S.; Radparvar, M.; Faris, S.M. (Hypress, Inc., Elmsford, NY (USA)). Oct 1987. 44p. NTIS, PC A03/MF A01.

A Terahertz Imaging Radar System which exploits superconductive electronics for all of its major components is described in this report. In particular, the importance of the superconducting millimeter(mm)-wave phase shifter in the development of such systems was fully investigated. The experimental and theoretical re-

sults presented are better than the authors expected to achieve under Phase I of the project. Conventional technology is unable to provide the high frequencies required to obtain small apertures for target acquisition. Superconducting technology offers a high-performance, very broadband and low-power, mm- and sub-mm wave phase shifter based on superconducting microstrips. The physics of the non-equilibrium superconductivity underlying the operation of the superconducting microstrip phase shifter has been studied. Theoretical analysis and numerous experimental results show that superconducting stripline modulation leading to phase velocity reduction and subsequent phase shift is achievable by quasi-particle injection. A digital N-bit phase shifter based on the superconducting microstrip transmission line is proposed for development. The implementations of such a mm and sub-mm wave phase shifter will fulfill a crucial need in the development of the Terahertz Imaging Radar.

37264 **(AD-A—190701/3/XAB) Composite-ceramic superconducting filaments for superconducting cable. Interim progress report, 16 October-15 December 1987.** Halloran, J.W. (Ceramics Process Systems Corp., Cambridge, MA (USA)). 5 Jan 1987. 94p. NTIS, PC A05/MF A01.

This is the second progress report of a five-month program to demonstrate the feasibility of manufacturing superconducting wires from $YBa_2Cu_3O_{7-x}$, consisting of a small ceramic core with a copper cladding. The ceramic core is to be produced from a dry-spun ceramic fiber, sintered to create a <010> fiber texture to enhance critical current. The sintered fiber is to be clad with copper by electroplating. The sintering and microstructure development of $YBa_2Cu_3O_{7-x}$ was characterized for as-calcined and milled powder, both as undoped and doped with 5wt% CuO. The undoped powder reaches 94% density, with fully recrystallized grains after 15 hours at 955 C. The CuO doped material sinters to full density at temperatures as low as 925 C, with extensive recrystallization. The resistivity was measured as a function of temperature for nearly dense and relatively porous undoped material.

37265 **(AD-A—190767/4/XAB) Potential field-expedient test for face mask integrity. Technical report, June-August 1986.** Krishnan, P.N.; Birenzvige, A.; Poziomek, E.J. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). Oct 1987. 26p. (CRDEC-TR—88012). NTIS, PC A03/MF A01.

In the battlefield situation, soldiers must don their protective masks when a chemical or biological threat is suspected (Figure 1). Once the soldier had donned his mask, proper fit is essential for maximum respiratory, eye, and skin protection in contaminated environments. Therefore, the assurance of proper fit after mask donning is of primary importance. In the laboratory evaluation of the protective masks, the leakage of a challenged aerosol is quantitatively measured using very-sensitive detection instrumentation. A study was conducted to determine the feasibility of developing a field-expedient method to test the integrity of a face mask. Cursory observation indicates that tobacco smoke odor can provide a protection factor on the order of 3000 which represents a potentially significant improvement over the protection factor provided by isoamyl acetate (banana oil), which is of the order 500 or less.

37266 **(CEA-CONF—9262) Non linear structures seismic analysis by modal synthesis.** Aita, S.; Brochard, D.; Guilbaud, D.; Gibert, R.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 13p. (In French). (CONF-8711193—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753468/JAW.

From Symposium on non linear behaviour of reinforced concrete submitted to a seismic excitation; Saint-Remy-Les-Chevreuse, France (25 Nov 1987).

The structures submitted to a seismic excitation, may present a great amplitude response which induces a non linear behaviour. These non linearities have an important influence on the response of the structure. Even in this case (local shocks) the modal synthesis method remains attractive. In this paper we will present the way of taking into account, a local non linearity (shock between structures) in the seismic response of structures, by using the modal synthesis method.

37267 **(CONF-880466—1) Application of superconducting technology to earth-to-orbit electromagnetic launch systems.** Hull, J.R.; Carney, L.M. (Argonne National Lab., IL (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009955/JAW.

From Conference on superconductivity and applications; Buffalo, NY, USA (18 Apr 1988).

Benefits may occur by incorporating superconductors, both existing and those currently under development, in one or more parts of a large-scale electromagnetic launch (EML) system that is capable of delivering payloads from the surface of the Earth to space. The use of superconductors for many of the EML components results in lower system losses; consequently, reductions in the size and number of energy storage devices are possible. Applied high-temperature superconductivity may eventually enable novel design concepts for energy distribtion and switching. All of these technical improvements have the potential to reduce system complexity and lower payload launch costs. 10 refs.

37268 **(CONF-880466—5) Use of high temperature superconductors in magnetoplasmadynamic systems.** Reed, C.B.; Sovey, J.S. (Argonne National Lab., IL (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011954/JAW.

From Conference on superconductivity and applications; Buffalo, NY, USA (18 Apr 1988).

The use of Tesla-class high-temperature superconducting magnets may have an extremely large impact on critical development issues (erosion, heat transfer, and performance) related to MPD thrusters and also may provide significant benefits in reducing the mass of magnetics used in the power processing system. These potential performance improvements, coupled with additional benefits of high-temperature superconductivity, provide a very strong motivation to develop high-temperature superconductivity (HTS) applied-field magnetoplasmadynamic (MPD) thruster propulsion systems. The application of HTS to MPD thruster propulsion systems may produce an enabling technology for these electric propulsion systems. This paper summarizes the impact that HTS may have upon MPD propulsion systems.

37269 **(CONF-880478—13) Application of superconducting technology to earth-to-orbit electromagnetic launch systems.** Carney, L.M. (Argonne National Lab., IL (USA)). 28 Jun 1988. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010022/JAW.

From 4. symposium on electromagnetic launch technology; Austin, TX, USA (12 Apr 1988).

This paper explores the potential benefits that may occur as a result of incorporating superconductors, both existing and those currently under development, in one or more parts of a large-scale electromagnetic launch system that is capable of delivering payloads from the earth's or lunar surface to space. Analysis indicates that superconducting components result in significant cost reductions for both rail and coaxial accelerator designs. 25 refs., 1 fig., 1 tab.

37270 **(CONF-880721—1) Optimization of performance criteria with bounded joint velocities for robots with one degree of redundancy.** Dubey, R.V.; Euler, J.A.; Babcock, S.M. (Tennessee Univ., Knoxville (USA). Dept. of Mechanical and Aerospace Engineering; Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. (CESAR—87/41). NTIS, PC A03;3. Order Number DE88003915/JAW.

From USA-Japan symposium on flexible automation; Minneapolis, MN, USA (18 Jul 1988).

Most kinematic control schemes for robots with redundant joints determine the joint motions for a desired end-effector trajectory such that a performance criterion is optimized. When the robot is in motion, it may reach a configuration in which the joint velocities required to optimize a performance criterion, while following a desired end-effector trajectory, may be extremely high.

This problem is referred to as an algorithmic singularity. The control scheme presented in this paper avoids high joint velocities by compromising optimization of the performance criterion in the neighborhood of an algorithmic singularity. This scheme does not require the pseudoinverse of the Jacobian and thus, it is computationally efficient and well suited for real-time implementation. Unlike other control schemes, the robot is not required to be an optimum configuration at the starting point. The application of this scheme to a seven-degree-of-freedom manipulator at the Center for Engineering Systems Advanced Research (CESAR) is described. 11 refs., 6 figs., 1 tab.

37271 (CONF-880741—2) Vibrational impacts of hush house operation. Witten, A.J. (Oak Ridge National Lab., TN (USA). Energy Div.). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006983/JAW.

From Joint CSCE-ASCE conference on environmental engineering; Vancouver, Canada (13 Jul 1988).

United States Air Force (USAF) facilities are required to test turboprop and turbojet engines before or after maintenance or repair and prior to installation on aircraft to ensure that no problems were introduced or remain uncorrected. This requirement prevents the installation of engines in aircraft which require further maintenance. There are a number of facilities in use by USAF for conducting engine diagnostic tests. The most modern of these facilities is the hush house which is a hangar-like structure designed to isolate the noise associated with extended engine operations from the surrounding environment. One type of hush house, the T-10, is of particular concern because of vibrational impacts to surrounding structures induced by subaudible sound (infrasound) emitted during operation. While these facilities fulfill the design requirement of reducing audible noise, serious siting problems have been reported at several installations because of infrasound-induced vibrations. The worst of these include the abandonment of an avionics laboratory because induced vibrations interfered with this facilities function and structural damage to a concrete block maintenance facility. This paper describes a predictive method for assessing vibration-driven structural impacts. 9 refs., 2 figs.

37272 (CONF-8609418—) Proceedings of the meeting on construction foundations in Nuremberg 1986. (Deutsche Gesellschaft fuer Erd- und Grundbau e.V., Essen (Germany, F.R.)). 1986. 591p. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88770213/JAW.

From Meeting and technical exhibition on construction foundations; Nuernberg, F.R. Germany (22 Sep 1986).

The main topics of the meeting were: The insulation of reservoir and disposal facilities, special problems at dams and embankments and new developments and experiences in underground engineering. Five papers from 32 were abstracted for the ENERGY database.

37273 (CONF-8805106—1) Stability control of leakage flow channels. Mulcahy, T.M.; Grotberg, J.B.; Prince, A.; Reiss, E.L. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Engineering Science and Applied Mathematics). 1988. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009995/JAW.

From 6. symposium on energy science; Argonne, IL, USA (4 May 1988).

Conditions for self-excited vibrations of channels conveying leakage flows are identified, including experimental results for an unconstricted slip joint. Several simple mathematical models of the interaction of the elastic channels and the flow are described, which should be useful for the identification and control of the structural instabilities. 12 refs., 5 figs.

37274 (DOE/ER—13598-2) A program to develop the engineering information necessary for the design of a cylindrical film reactor: Progress report. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). [1988]. Contract FG02-86ER13598. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009885/JAW.

The second year of a proposed three-year research program (performed in conjunction with Carnegie-Mellon University) to study the "cylindrical film" chemical reactor has concentrated on determination of gas flow rates and nozzle injection procedures within the cylindrical film volume which allows stable operation of the reactor. Our studies have concentrated primarily upon determination of the amounts of air which can be injected into various nozzle configurations at differing flow rates. "Stability plots" have been made for six different nozzles: five and ten centimeter diameter annuli with gap spacing of 0.5, 1, and 2 millimeters. Only a relatively narrow band of stable configurations exist.

37275 (DOE/ER/13306—10) Model uncertainty, process design, and process control. Skogestad, S.; Morari, M. (California Inst. of Tech., Pasadena (USA)). 1985. Contract FG03-85ER13306. 42p. (CONF-851123—13). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012172/JAW.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

It has been shown previouly that the quality of control achievable for a certain system (its dynamic resilience) is limited by the nonminimum phase characteristics of the plant, constraints on the manipulated variables and model uncertainty. Model uncertainty requires the controller to be detuned and performance to be sacrificed. The goal of this paper is to quantify this well known qualitative statement. A general discussion of the model uncertainty problem is followed by the derivation of simple bounds on the nominal performance imposed by the robust stability condition for some uncertainty descriptions. These bounds are relatively easy to evaluate and should be effective tools for screening alternate designs in terms of their resilience characteristics. It is shown that the use of the minimized condition number as a sensitivity measure implicity assumes that the relative errors of the transfer matrix elements are independent and have similar magnitude bounds.

37276 (DOE/NV/10322—32) Use of finite element methods in the design of drilling related equipment at the Nevada Test Site. (Fenix and Scisson, Inc., Mercury, NV (USA)). May 1988. Contract AC08-84NV10322. 23p. (CONF-8805108—1). NTIS, PC A03;3. Order Number DE88008670/JAW.

From Institute of shaft drilling technology annual conference; Las Vegas, NV, USA (11 May 1988).

Finite Element Analysis is being used successfully at the Nevada Test Site in the design of new large diameter drilling equipment. It is also used in design modifications to existing equipment. This paper presents the following three design problems solved by using Finite Element Methods: Fillet weld design for stiffener ring to large diameter casing; subbase design for 1,400,000 lb. load; and pipe gripper stress analysis for automatic pipe handler. 14 figs., 3 tabs.

37277 (DP-MS—88-19) Efficient and safe hot air heating of size 5A/B UF_6 cylinders. Binstock, G.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 5p. (CONF-880558—7). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009011/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

An efficient and safe means for unloading size 5 VHE uranium hexafluoride (UF_6) cylinders using hot air has been developed and tested at the Savannah River Plant (SRP). Hot air impinges directly on the cylinder through hundreds of small holes close to the cylinder surface. A cylinder of UF_6 can be unloaded in about 10 hours at an air temperature of 100{degree}C. The forced convection heating system replaced a natural convection heater in which the UF_6 cylinder was placed in the center of an electrical resistance-heated 6-in. pipe. A comparison of the two types of he using forced convection is 11.5 Btu/(hr)(ft²)({degree}F) as compared to 3.9 Btu/(hr)(ft²)({degree}F) for the natural convection heater. The measured heat transfer coefficient for the forced convection heater is compared to correlations. Hot air heating also provides improved cylinder heating safety by increasing the unloading rates while operating at a low cylinder temperature, providing a large margin of safety against a hydraulic cylinder rupture. Administrative and en-

gineered safety features to prevent high cylinder pressures and UF_6 leaks are discussed. 1 ref., 3 figs., 1 tab.

37278 (DPST—86-340) Analysis of DWPF sample station experimental design. Postles, R.L. (Savannah River Lab., Aiken, SC (USA)). 20 Mar 1986. Contract AC09-76SR00001. 49p. NTIS, PC A03;3. Order Number DE88009573/JAW.

Data in this document were derived from observations from the Slurry Receipt & Adjustment Tank (SRAT) and Slurry Mix Evaporator (SME). The Standard dip-tube sampler produced samples from the 79in., 94 in., and 169 in. levels; while the Prototype sampler obtained samples very near the tank bottom. Replicate Samples were gathered at each level and replicate Analyses made on each. The Analysis is Weight % Solids obtained through use of a microwave drying procedure. The issue of whether or not the tank contents are homogeneous devolves into whether there are detectable differences between levels. Comparison of the 3 levels within the Standard sampler gives the cleanest contrast, in that it is unconfounded with Prototype-to-Standard effects. The Prototype does provide a 4th level, but at the cost of inflating the Level-to-Level contrast with whatever Prototype-to-Standard differences exist. Hence, Level-to-Level differences were computed within the Standard sampler.

37279 (FMPC—2137) Safety analysis report for packaging DOT [Department of Transportation] specification 17H (30 and 55 gallon) and 17C (55 gallon) steel drums for slightly enriched uranium metal and uranium residues. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 13 May 1988. Contract AC05-86OR21600. 217p. NTIS, PC A10;3. Order Number DE88011285/JAW.

An analytical evaluation of the DOT 17C and 17H steel Drums has been made to demonstrate its compliance with regulations governing the offsite shipment of radioactive materials. The evaluation encompasses four primary categories: structural integrity, thermal integrity, nuclear criticality safety and quality assurance. The results of this evaluation show that the drums comply with the regulations, for the shipment of various uranium metal shapes and residue enriched up to 1.25 wt.% ^{235}U. 23 refs., 24 figs., 11 tabs.

37280 (FNAL-TM—1514) Argon spill test for E706. Kilmer, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). 17 Mar 1988. Contract AC02-76CH03000. 12p. NTIS, PC A03;3. Order Number DE88010654/JAW.

There were three different tests involved in this series. It should be stated that the purpose of the test was to determine if there should be extra precautions taken with the calorimeter vent stack. No attempt was made to do quantitative measurements. The three types of tests were diffusion tests, spills at a remote site, and a spill at the MW building. Oxygen monitors used were the standard Energy Saver type throughout. 6 figs.

37281 (Juel-Spez—411) Data acquisition and control of the 370 TBq high-pressure tritium doping device, TRIBA. Pfeil, A.; Heer, H.; Laesser, R.; Klatt, K.H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentrallabor fuer Elektronik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung). Jul 1987. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753575/JAW.

The report is arranged as follows: After an introduction, the first section briefly discusses measured values obtained with the 37 TBq (10^3 Ci) doping device with a view to the enhanced measuring range that is achievable with the newly developed 370 TBq (10^4 Ci) device. Sections 3 and 4 explain the technical design of the device and the measuring and control equipment connected to the computer. All following sections are detailed descriptions of the computer configuration and the software.

37282 (K/ETAC—57) Verification of the ADINA finite element code for creep analysis: problems from the open literature. McGrath, S.V.; Faulkner, M.A.; Bass, B.R.; Johnson, W.G. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OT21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011826/JAW.

This report presents the ADINA finite element analysis of several sample creep problems taken from the open literature. In addition to creep, the nonlinearities of plasticity and geometric stiffness are addressed.

37283 (K/ETAC—64) Naval underwater systems center torpedo data acquisition system: Wet system conceptual design report. Adams, D.J.; Beshears, D.L.; Capps, G.J.; Jordan, J.K.; Ott, G.W.; Scudiere, M.B.; White, C.P.; Nodine, R.N.; Todd, R.A. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OT21400. 59p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010155/JAW.

In the process of developing technology for torpedo applications, Naval test vehicles are instrumented with sensors (and signal processors), and their outputs are recorded during in-water exercises. This paper defines the coneptual design for a state-of-the-art on-board torpedo digital data acquisition system which will be used to monitor and record an enormous volume of data from transducer signals during either routine or development in-water exercises.

37284 (K/QT—198) OOO stage equipment bearing performance with a lower viscosity lubricant. Lannom, D.C. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OT21400. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011827/JAW.

One of the Gaseous Diffusion Ultimate Potential (GDUP) projects involves a study of methods to reduce process equipment bearing power losses. In support of this effort, an analytical study has been completed which assesses the performance and expected benefits of operating the 000 stage equipment with a lower viscosity lubricant. Fluid film bearing analysis codes were employed to study 000 stage compressor and motor bearings. Correlations depicting bearing minimum film thickness and power loss with variable lubricant inlet temperature are presented for two lubricants: (1) code BG oil (310 SSU at. 100 F) and code BE oil (150 SSU at. 100 F).

37285 (K/QT—201) Thermal properties evaluation of UF_6 cylinder overpack insulation. Frazier, J.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1988. Contract AC05-84OT21400. 2p. (CONF-880558—6). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009485/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

A phenolic foam is incorporated into the design and construction of UF_6 cylinder shipping containers known as overpacks. The overpack provides mechanical and thermal protection to UF_6 product cylinders during transport. The phenolic foam is utilized for thermal insulation. An important criterion in overpack design is to limit temperature excursions of the product cylinder below the triple point of UF_6, preventing possible overpressurization of the cylinder. A current requirement is that the product cylinder wall temperature be maintained below the UF_6 triple point with the outer surfaces of the overpack exposed to 1475{degree}F for thirty minutes. A possible heat source is the close proximity of a fire. Overpack thermal protection design requires thermal properties data for the materials of construction, particularly for the phenolic foam insulation which provides the primary thermal resistance. Thermal conductivity and heat capacity data for the phenolic foam are limited in the literature. Accurate heat transfer models of the overpack require thermal properties spanning the ange from room temperature to 1475{degree}F. An experimental program was devised to measure the thermal conductivity and heat capacity of the insulating foam over the temperature span of interest.

37286 (LA-UR—88-865) Design and testing of a prototype water-cooled vacuum interrupter for use in superconducting magnet protection circuits. Parsons, W.M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-880687—4). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007888/JAW.

From 13. international symposium on discharges and electrical insulation in vacuum; Paris, France (27 Jun 1988).

A water-cooled vacuum interrupter was designed and tested for use at 25 kA and 10 kV. This device is expected to have a lifetime approximately one order of magnitude greater than commercial dc circuit breakers. Testing showed that, although the device could successfully carry and interrupt 25 kA, interruption reliabililty was only about 95% with a 10 kV recovery voltage. In addition, a structural crack developed in one electrode from either thermal or mechanical stresses or a combination thereof. 11 refs., 4 figs., 1 tab.

37287 (LA-UR—88-1192) Steps toward lunar settlement. Jones, E.M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 12p. (CONF-880594—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009141/JAW.

From 100. meeting of the Australia and New Zealand Association for the Advancement of Science; Sydney, Australia (17 May 1988).

The costs of transporting people and material to low-earth-orbit (LEO), and thence to the lunar surface, will constrain the pace and pattern of lunar development. Beginning as a spartan "base camp" completely supplied from Earth, a lunar science-and-resource-development facility could grow in size, amenities, and capability to the point that passenger transport becomes a major expense. At such a stage, some employees of the facility might be given the opportunity to become permanent residents; and at that point, lunar settlement will have begun. We assume growth rates of facilities and staff contained by the annual delivery of 900 tons to LEO. During the base camp era, about 100 tons would be delivered annually to the lunar surface. Within six years, the facility could grow to a collection of 25 modules, housing a staff of about 16 with each member of the staff serving a six-month tour on a staggered schedule. At the end of this first phase, oxygen produced from lunar ilmenite and delivered to lunar orbit for use as propellant would allow annual lunar-bound cargos of about 200 tons. Production from lunar materials of heat shields for aerobraking would enable economical delivery of lunar oxygen to LEO and, therefore, could raise lunar-bound cargoes to about 450 tons. Accumulatin of production capabilities would eventually allow use of lunar construction materials, to build farms and increase per capita living and working space. Once closed-loop environmental systems are in place, transport costs are dominated by staff rotation and the facility is limited to a maximum staff size of about 300. Further expansion requires that some staff become permanent residents.

37288 (LBL—24321) Fabrication of Rutherford-type superconducting cables for construction of dipole magnets. Scanlan, R.M.; Royet, J.; Hannaford, R. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 10p. (CONF-880653—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012027/JAW.

From International conference on cryogenic materials applications and properties; Shenyang, China (7 Jun 1988).

An experimental cabling machine has been constructed and used to investigate the fabrication of a variety of superconducting cables. These include the 23-strand and 30-strand NbTi alloy cables for the Superconducting Supercollider (SSC) and a number of experimental cables. The experimental cables include 24-strands and 36-strands as well as two-level cables with a 6 or 7-strand first level and 23 or 30-strand second level. These results were used to aid in selecting the optimum cable for the SSC dipole and quadrupole magnets. As a result of these studies, cable can now be fabricated to exacting mechanical tolerances (+/- .006 mm) and with low critical current degradation (2-5%). In addition, tooling design studies have been performed and a Prototype SSC Production Cabling Machine has been designed. The results of the cable optimization studies and the tooling design studies will be discussed. SSC cable production experience on the experimental cabling machine and the production cabling machine will be reported.

37289 (LNCC—030/87) Numerical model to analyse the impact between piping and gapped restraints. Galeao, A.C.N.R.; Guerreiro, J.N.C.; Loula, A.F.D. (Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro (Brazil)). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702465/JAW.

An algorithm to solve the impact between deformable bodies and rigid gapped restrains is presented. This kind of problem occurs in structures of nuclear power plants. This algorithm combines the Newmark method with an impact model which simulates the impulsive force as a retangular pulse. When several restraints are presented the equilibrium and the unilateral conditions are simultaneouly attained by means of an iterative scheme which deals with a reduced flexibility matrix, of the order of the number of unilateral restraints, to avoid the use of the whole matrix of the system. Some numerical examples solved with the proposed algorithm show that no numerical instabilities occur.

37290 (ORNL/TM—9562) Enhancement of ASPEN's [Advanced System for Process ENgineering] equipment cost estimation system. Johnson, P.J.; Myers, M.L.; Begovich, J.M. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 149p. NTIS, PC E07/MF A01; 1; GPO Dep. Order Number DE88009005/JAW.

Includes 2 sheets of 48x reduction microfiche.

Nine new captial equipment costing models have been developed for the VAX 11/780 version of ASPEN (Advanced System for Process ENgineering). The new equipment cost models and three existing ASPEN models which are revised, reflect equipment items typically found in large scale synthetic fuel plants. Included in this report are the new ASPEN User and Technical Reference Manual sections (Appendixes A and B), the FORTMAN subroutines, the code required to revise the ASPEN program (Appendixes D and E), and results from each of the new and revised cost models (in tables in the body of the report).

37291 (ORNL/TM—10524) Test results: The manipulator operator skill test: Consolidated Fuel Reprocessing Program. Draper, J.V.; Omori, E.; Harville, D.L.; Wrisberg, C.A.; Handel, S.J. (Oak Ridge National Lab., TN (USA); Human Machine Interfaces, Inc., Knoxville, TN (USA); Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Nov 1987. Contract AC05-84OR21400. 22p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88003751/JAW.

The Manipulator Operator Skill Test (MOST) was developed to measure important servomanipulator operator skills. The MOST is based on careful analysis of servomanipulator motions and prototypical remote maintenance tasks. It has been validated with servomanipulator operators from the Oak Ridge National Laboratory (ORNL). This report details the development of the MOST and describes testing carried out with it. Skill test development followed a three-stage strategy. First, a list of job elements deemed important to performance of remote handling tasks was generated. Next, this list was culled for skills which seemed particularly important for maintenance of process-type equipment that will be found in future nuclear reprocessing facilities. Finally, a task was designed that measured key skills, and a procedure for performing the task was developed. The predictive validity of the skill test has been assessed at ORNL. Ten servomanipulator operators participated in a study to determine how well performance of the skill test predicts performance of a realistic remote maintenance task. Multiple linear regression found that the time required to complete the skill test is an effective predictor of realistic task completion time. The multiple R for the predictive equation was 0.97. 4 refs., 6 figs., 7 tabs.

37292 (PB—88-863642/XAB) Sensors and detectors based on superconducting devices. July 1972-May 1988 (Citations from the International Aerospace Abstracts data base). Report for July 1972-May 1988. (National Technical Information Service, Springfield, VA (USA)). May 1988. 131p. NTIS PC N01/MF N01.

Supersedes PB—87-861845; U.S. sales only.

This bibliography contains citations concerning gradiometers, magnetometers, and infrared detectors which use superconductors to improve sensitivity. Applications include biomagnetic measurements for medical studies, gravity-wave experiments, geomagnetism and ocean bottom magnetic exploration, galvanometers and voltmeters, astronomical telescopes, and bolometers and radiometers. Some articles refer to design considerations for cooling systems for the sensors and detectors. (This updated bibliography contains 315 citations, 87 of which are new entries to the previous edition.)

37293 **(SAND—87-0758C) Thermal response of a Type B radioactive transport container.** Moya, J.L.; Akau, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 30p. (CONF-880724—17). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006451/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

The Beneficial Uses Shipping System (BUSS) cask is a Type-B, passively cooled container designed to transport irradiation source capsules of cesium chloride or strontium flouride. A full-scale thermal test was conducted on an internally-instrumented cask using actual radioactive capsules. The measured transient temperatures were compared to the results obtained from two distinct thermal codes and a fluid dynamics model was developed to study the fluid flow at the cask surface. In addition, the calculated and measured transient thermal responses were used to develop a methodology for predicting the cask thermal load, given the surface temperature at a particular time. 10 refs., 13 figs., 1 tab.

37294 **(SAND—87-7123) Safety assessment for W82 spinner.** Wavrik, R.W. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Mar 1988. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number TI88008006/JAW.

A safety analysis is provided for the W82 spinners that the Oak Ridge Gaseous Diffusion Plant furnishes the Sandia National Laboratory, Albuquerque, and the Bendix Corporation, Kansas City. An assessment of the containment, torsional mounting, air turbine, lid closure, explosive hazard, safety interlocks, and secondary personnel protection is evaluated using the latest available engineering data and containment experience derived from {approximately}25 years of gas centrifuge devlopment and operation. This report is revised to specifically evaluate the spin tester to contain the W-82 telemetry (TM) fixture with a moment of inertia of 4.1 in.-lb-s^2 operating at a speed of 18,000 rpm with an energy level of 7,283,768 in.-lb. The neutron detector (ND) fixture is also covered under the TM limitation because its moment of inertia is 0.33 in.-lb-s^2 with 22,000 rpm operation and an energy level of 875,762 in.-lb.

37295 **(SAND—88-0145) High-velocity impact testing of an accident resistant container using a large centrifuge.** Garcia, J.R.; Weatherbee, R.L. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 16p. NTIS, PC A03;3. Order Number DE88010972/JAW.

An impact test technique using the 35-ft centrifuge located in area III at Sandia National Laboratories in Albuquerque, New Mexico is described. An Accident Resistant Container was thrown into a hard target at impact velocities of up to 425 ft/s using the tangential velocity of the centrifuge. The dynamics of motion in a curvilinear path, design considerations and limitations, hardware, target setup, release mechanism, and instrumentation are discussed. 3 refs., 9 figs.

37296 **(SAND—88-0260) An investigation of soft launch and instability breakup with a two-stage light gas gun.** Grady, D.E.; Moody, R.L. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010371/JAW.

Exploratory research has been performed in the use of a two-stage light gas gun facility to investigate the soft acceleration and breakup physics of rapidly launched thin plates. A flash radiograph system was joined with the gun facility to provide the principal diagnostic. In the study, radiographs of thin-plate acceleration and breakup were obtained.

37297 **(SAND—88-0518) REGGIE: A 2-D reconnection gun code.** Freeman, J.R. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010975/JAW.

A simulation code has been written to model the reconnection gun mass accelerator. The code includes the effects of magnetic flux diffusion and convection. The model is based on the solution of a 2-D time-dependent vector potential equation. This solution provides the magnetic force required to compute the self-consistent acceleration of the projectile. The numerical construct of the code is presented. Comparsions with experiments that measured the time-dependent velocity and displacement are also presented. The results show the effects of a late-time braking force. The origins of this force are discussed within.

37298 **(SAND—88-0519C) Airborne remote operated device.** Arlowe, H.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 14p. (CONF-880689—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010324/JAW.

From 15. AUVS annual technical symposium; San Diego, CA, USA (6 Jun 1988).

Sandia National Laboratories has recently delivered ten ducted fan airborne reconnaissance vehicles to the US Marine Corps for training and evaluation. This Airborne Remote Operated Device (AROD) concept centers on a ducted fan lifting technique that uses on-board attitude sensors and a stabilization computer to minimize the operator training requirements. These vehicles have been flown under a variety of conditions for over twelve hours. Video tapes of various flights and on-board camera views will be shown. This paper will cover the design, construction, testing, and operator training. Component reliability will be discussed as well as payload options., performance, and possible future program directors such as size, weight, communications, navigation, and operator aids. The paper will conclude that the concept of the AROD vehicle has been well demonstrated and is ready for use in solving problems of noise, communications, navigation, and integration into military tactical structures.

37299 **(SAND—88-0562) Human interfaces in remote driving.** McGovern, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 6p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008411/JAW.

Driving vehicles through remote control (teleoperation) can allow the human operator to take actions at a distance. Human effectiveness can be projected into locations which may be hazardous. In order for the operator to control the motion of these vehicles, knowledge of the vehicle environment and status need to be available. This requires a system consisting of vehicle, communication link and human operator. Much work has been done in vehicle and communication system design but comparatively little effort has been devoted to the human interface. In this paper, experimental studies of remote driving are reviewed to approach an understanding of what is known. Summary data is presented for experimental work performed at Sandia National Labs in vehicle vision systems. This information is combined with the experience base developed through several years requiring additional development effort.

37300 **(SAND—88-1222C) A demonstration of retro-traverse using a semi-autonomous land vehicle.** McGovern, D.E.; Klarer, P.R.; Jones, D.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-8806118—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009851/JAW.

From Conference on space and military applications of automation and robotics; Huntsville, AL, USA (13 Jun 1988).

A Jeep Cherokee has been modified by Sandia National Laboratories to allow remote control either by teleoperation or

through computer generated commands (autonomy). This vehicle has been used for development of hardware and software and in the demonstration of concepts for computer augmentation of remote controlled vehicles. As part of this activity, a system has been configured which allows an operator to teleoperate the vehicle from one location (home base) to another (destination). At the completion of teleoperation, the operator can instruct the vehicle to return to the starting position. The vehicle then autonomously performs a retro-tranverse, reversing the path by which it reached its destination. During teleoperation, operator commands are given through an operator control interface consisting of a steering wheel, brake and throttle pedals, and a video display. Commands are transmitted to the vehicle and video returned from the vehicle over RF communication links. Periodic way points are automatically recorded for later use by the vehicle system. Navigation during retro-traverse utilizes dead-reckoning inputs from an odometer, compass and steering angle potentiometer. Way points (previously identified during teleoperation of the vehicle) are linked by short, straight line segments. Along each path segment, the control system generates the steering and speed commands necessary to direct the vehicle towards the next way point. Retro-traverse has been demonstrated over open terrain at Sandia National Laboratories. Path following accuracy and final positional control is a function of dead-reckoning system limitations and control system design. These limitations are discussed, and an improved system is proposed. 10 refs., 5 figs.

37301 (SVF—249) Method for x-ray radiography of insulating covers of culverts for district heating pipes. Dahn, S. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Feb 1987. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753343/JAW.

A special procedure using tangential x-ray beam direction, very low kilovoltage and x-ray sensitive IC-paper (Instant copy paper) has been developed for practical field application. The main advantages with IC-paper instead of transparent film are lower 'raw-film' cost, much faster and easier development process and thereby a quicker result. When the x-ray technique is applied on piping dimensions 250-500 mm it has been proven that the sensitivity corresponds to the visibility of a radially drilled hole of diameter 3-4 mm through the foam layer. A proper way to verify the image quality has been found to be of major importance, why a special image quality indicator has been designed and tested. This reference body of same dimension as the pipe to be radiographed contains three sections of foam with different densities and has a series of radially drilled holes e.g. 3-4-5-7 and 10 mm. The reference body is to be exposed together with the examined pipe. As unfiltred radiation from a Beryllium window x-ray tube is used, some radiation shielding is necessary for field work. In addition accurate and reproduceable focus-to-film distance is important for reproducible exposure doses. By these reasons two models of telescopic exposure boxes of aluminium have been manufactured and tested under field conditions. In the actual project, also a study of non film techniques was included. The use of x-ray sensitive photo diodes in CCD-coupling as receiving elements was found to be of great interest for primarily examination of straight pipes in the production line. The IC-paper technique was also tested on two circumferential weld joints in steel pipes 139.7 x 3.6 mm containing significant weld defects. The result was clearly positive and indicates the possibility to use the IC method as either a supplement or a substitute to the conventional method with transparent x-ray films.

37302 (SVF—256) Temperature rise of pipelines and cables adjacent to buried district heating pipelines. Carlsson, H.; Molin, J. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). 2 Dec 1986. 50p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752982/JAW.

In this study the temperature distribution in the soil around a district heating pipeline has been calculated. The calculations have been performed for three different cases, summer, winter and yearly average. Climate data for southern Sweden has been used in the calculations. The calculations have been made for PUR-culverts with dimensions DN 25, DN 300 and DN 800, serie 2. The temperature calculations show that the soil temperature near the culvert can reach +25 degrees C during summer while the soil temperature during winter normally is lower. However, below the culvert the soil temperature can raise to +30 degrees C during winter at +120 degrees C water temperature. The effect of the increased soil temperature has been dealt with as water and sewage pipelines, gas pipelines, telecommunication and power cables are concerned. For water and gas pipelines the increase of temperature will be maximum when the flow in the pipeline is zero and this is the only case studied here. Considering the effect of elevated temperature for the different pipelines and cables, recommendations for minimum distances to a district heating pipeline have been given. For certain cases a thermal insulation is recommended between the heating culvert and the adjacent pipelines or cables. (authors).

37303 (SVF—257) Damage on jacketed pipe joints. Ljungqvist, J.; Oddving, B.; Westin, R. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Mar 1987. 59p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752983/JAW.

The project comprises three moments, two of which cover damage and protection against moisture entering the joints. The third moment describes various measuring methods of moisture on the end surfaces of joints. (G.B.).

37304 (SVF—258) Stress analysis of district heating pipes. Pt 3 Dimensioning instructions and program for T-joints. Andersson, S.; Carlsson, H.; Molin, J. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Mar 1987. 46p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752984/JAW.

The design of a pipe system includes calculations of stresses and displacements in straight pipes, curved pipes and branch connections. This report considers the design of branch connections. Stress indices are evaluated only for moment loading. The directions for the design given in this report are valid only for T-joints with a moderate axial force in the branch connection. Expressions are given for calculation of the flexibility in branch connections by using flexibility factors. Stress indices and flexibility factors has been calculated for four different types of T-joints. For each type a number of combinations of pipe dimensions have been analyzed. Branch connections in buried district heating pipe system have been studied. Diagram and tables have been prepared for some frequently occuring design situations. Two cases have been studied, on one hand when axial movement in the branch connection can be neglected on the other when axial movement in the run pipe can be neglected. (authors).

37305 (TKK-KO/LVI—B13) Methods for evaluation of the condition of the water and sewage piping system in blocks of flats. Jaervinen, J.; Jokinen, M.; Tavi, M.; Seppaenen, O.; Forsen, O. (Helsinki Univ. of Technology, Otaniemi (Finland)). 1987. 186p. (In Finnish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88752861/JAW.

This research was made to develope a method for evaluation of the condition of the water and sewage piping system in blocks of flats. The research was mainly made in the Laboratory of Heating, Ventilating and Air-conditioning of the Helsinki University of Technology. The report includes a summary of the materials and installations used in Finland starting from 1920's. The corrosion of various materials used in piping was studied theoretically and experimentally. The methods applicable to the investigation of piping have been reported and tested in 15 test buildings located in the metropolitan area of Helsinki. The year of construction of the buildings varied between 1911 and 1959. After the preliminary tests in test buildings a method for evaluation of the condition of plumbing system was developed. The method was tested in a building that was under renovation. The method gives possibilities to obtain savings when acceptable parts of plumbing can be preserved and investments postponed.

37306 (UCID—21344) Identification procedure for wire and cable jacket insulations. Priante, S.J. (Lawrence Livermore National Lab., CA (USA)). 11 Jan 1988. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008408/JAW.

The fire science group evaluated the flammability of various electrical cable insulations, and also investigated methods to identi-

fy the composition of in-place cable insulations. We used thermogravimetric analysis and differential scanning calorimetry to compile thermograms of various insulation materials. We have compiled this information into a library of thermograms for identification cable insulations. This paper descibes our analysis and gives an index of our library.

37307 **(UCID—21351) Activities in HPM effects phenomenology at LLNL under the DNA/SDI Lth-6 effort.** Cabayan, H.S.; King, R.J. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008409/JAW.

During the fiscal years 1984-1986, DNA funded an effort at the Lawrence Livermore National Laboratory under the SDI/Lth-6 program to develop models and to study the phenomenology of HPM interaction with systems. The effort concentrated on the following areas: linear coupling/modeling; linear coupling/experiments; nonlinear coupling/modeling; component failure/modeling; component characterization; and electronic subsystem characterization. This report sumarizes these subject areas.

37308 **(UCRL—98703) SSVCO feed characteristics.** Vogtlin, G.E. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 11p. (CONF-8805132—1; CONF-8805132—). NTIS, PC A03;3. Order Number DE88011322/JAW.

From 4. national high power microwave conference; Monterey, CA, USA (9 May 1988).

The Livermore SSVCO has been modeled with 2-D and 3-D finite element electromagnetic codes. The techniques used and results will be described. These codes were recently developed at Lawrence Livermore National Labs. They permit sinusoidal driven nodes, absorber and metal surfaces. Contour plots are available of E-fields, H-fields all axes, total E or H-fields and in the 2-D case, Poynting vectors. 8 refs.

37309 **(UCRL—98704) Insulator design options.** Vogtlin, G.E.; Hofer, W.W.; Wilson, M.J. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 11p. (CONF-8805132—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011321/JAW.

From 4. national high power microwave conference; Monterey, CA, USA (9 May 1988).

Insulators are being designed and tested at Livermore to minimize size and weight. Modeling has taken into account charge accumulation due to electron emission. Insulators with a 45{degree} cone angle have been tested with both polarities of applied voltage across the insulator. Techniques have been developed to shield triple points and reduce the maximum surface stress by using conducting grooves in the insulators. Tests have been conducted with a 1.2 megavolt, 1 microsecond Marx generator and a 3 nanosecond, 400 kV pulse generator. 3 refs.

37310 **(VTT-TIED—774) Hydraulic pumps and hydraulic equipment at low temperatures.** Soudunsaari, R.; Lehto, A. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1987. 76p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752871/JAW.

The ambient temperature may be -40 - -60 deg C in arctic conditions. This causes hardening and shrinkage of seals, deterioration of the suction ability of hydraulic pumps, brittleness in metals and more viscous hydraulic fluids. This may result in oil leakages and component damage. The suction ability of a piston pump, a vane pump and a gear pump was measured at low temperatures. Mineral oil based hydraulic fluid and synthetic fluid were used. The viscosities of the oils during the tests were above the maximum values recommended by the pump manufacturers. The suction ability of each pump was good. The housing of the vane pump broke in a test carried out at -40 deg C. The cooling of the oil in the tank during the night can be decreased by at least 10-12 deg C by insulation. It is recommendable to use a rotating heater to heat up the oil in different parts of the tank. Assemblies composed of hydraulic tubes and hydraulic tube fittings are tight also at low temperatures if they have been carefully mounted and they are under no external strain. The operation of liquid level switches was good at low temperatures. The connecting pressure of pressure switches normally increased when the temperature decreased and the test pressure increased rapidly. Pressure gauges filled with glycerine are not suitable for use at low temperatures.

37311 **(VTT-TIED—788) Pressure tests of tubes at high temperature.** Maekelae, U.; Jokinen, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Nov 1987. 25p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752998/JAW.

A single creep testing rig has been developed for testing hightemperature tubing under high pressure. The equipment consists of pressurizing unit, furnace and control unit, and includes various features for operator safety. The testing rig is being used for simulating the behaviour of tubes of the hightemperature equipment in power and process industry. Results achieved by the rig are more exact in life time prediction of a component than life time estimation calculations and creep tests.

37312 **(VTT-TUTK—493) Safety of the use of coal power. Part 2. Experiments with silo storage of coal.** Rautalin, A.; Aeijaelae, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1987. 45p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752874/JAW.

Knowledge obtained from literature on storage technique of coal crush and powder was completed by storage experiments in Finland's conditions. Storage equipment was instrumented to obtain a good conception of phenomena during storage. Storage of granular coal prepared by sieving, without crushing, was found to be safe even during long-term storage, as regards spontaneous ignition and formation of combustible gases. This coal grade did not show any susceptibility to spontancous ignition.Tendency of granular coal to freezing should be considered in the design of the silo, as no heat generation occurs in the coal or it is very slow. Processing of coal powder, for example, grinding temperature and temperature of coal power when entering the storage, is of great significance to its behaviour in storage. The experiments indicated that coal storage can be managed by monitoring conditions in the storage and by taking necessary measures on the basis of the monitoring results.

37313 **State identification of GaAs(1-bar1-bar1-bar) oxidized surfaces by an x-ray photoemission decomposition method.** Gomez-Goni, J.; Munoz, M.C.; Lopez de Ceballos, I.; Sacedon, J.L. (Instituto de Ciencia de Materiales (CSIC), Serrano 144, E-28006 Madrid, Spain). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 4, 2238-2242(Jul 1988).

An x-ray photoemission (XPS) decomposition method has been applied to the oxidation of GaAs(1-bar1-bar1-bar) surfaces, in order to identify the oxidation states. The method, which is based on Fourier transform theory, provides separation of overlap composite spectra into its individual components. The incorporation of truncation techniques, which reduces the spurious structure, allows its application to real unresolved As, Ga, and oxygen core level XPS spectra of oxidized GaAs surfaces. The calculated number and chemical shifts of the Ga and As oxide compounds are in very good agreement with the results obtained by the synthesis method. At least three different forms of bound oxygen, β_3, β_1, and O/sup //sup = /, with chemical shifts of -0.7 eV for the β_2 and 0.9 eV for the O/sup //sup = / referred to the β_1 state, are resolved in the oxygen (1s) XPS spectra.

37314 **Reinforced flexural elements for TEMP-STRESS program.** Marchertas, A.H.; Kennedy, J.M.; Pfeiffer, P.A. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nuclear Engineering and Design;* **106**: No. 1, 87-102(Feb 1988). Contract W-31-109-ENG-38.

The implementation of reinforced flexural elements into the thermal-mechanical finite element program TEMP-STRESS is described. With explicit temporal integration and dynamic relaxation capabilities in the program, the flexural elements provide an efficient method for the treatment of reinforced structures subjected to transient and static loads. The capability of the computer program is illustrated by the solution of several examples: the simulation of a

reinforced concrete beam; simulations of a reinforced concrete containment shell which is subjected to internal pressurization, thermal gradients through the walls, and transient pressure loads. The results of this analysis are relevant in the structural design/safety evaluations of typical reactor containment structures.

37315 **Numerical algorithm for analyzing piping response to thermal transients and seismic excitations.** Wang Chungyi. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nuclear Engineering and Design;* **106:** No. 1, 147-160(Feb 1988). Contract W-31-109-ENG-38.

This paper describes a three-dimensional finite-element method for the structural response analyses of reactor piping systems subjected to thermal transients and seismic excitations. In the thermal-transient analysis, the algorithm appropriately accounts for stresses arising from the temperature dependence of the elastic material properties, the thermal expansion of the materials, and the change in the temperature-dependent yield surface. It includes a thermoviscoplastic constitutive equation that incorporates capabilities of treating thermal softening, failure, strain rate, creep, and stress ratcheting. In the piping seismic analysis, a time-history method is utilized to account for possible nonlinear phenomena as well as to reduce the solution conservatism obtained from response-spectrum analyses. Variation in dominant stress frequencies and translational frequencies are easily handled. The algorithm described herein has been integrated with the implicit time-integration scheme for treating hoop, flexural, axial, and torsion deformations induced by these accident loads. It is valid for large displacement and rotations, but small strains. Both geometrical and material nonlinearities are considered. To illustrate the methodology, several sample problems are given. Results show that this approach is extremely efficient and is suitable for long-duration analyses of reactor piping systems.

4203 Lasers

REFER ALSO TO CITATION(S) 36705, 36961, 37375, 37619, 37629, 38524, 38552, 38761

37316 **(AD-A—189956/6/XAB) Research at Lincoln Laboratory leading up to the development of the injection laser in 1962.** Rediker, R.H. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Jun 1987. 5p. (JA—5921). NTIS, PC A02/MF A01.

Pub. in IEEE Jnl. on Quantum Electronics, Vol. QE-23, No. 6, 692-695(Jun 1987).

In 1958 the Semiconductor Device Group at Lincoln Laboratory began to concentrate its efforts on exploiting GaAs. these efforts, in addition to yielding diodes which ns switching speeds, led to the development in early 1962 of diodes that emitted near-bandgap radiation with very high efficiency, and to the development in October 1962 of the diode laser. The theory of the semiconductor laser developed at Lincoln Laboratory in the mid-to-late 1950's provided the foundation necessary for the design of the diode laser structure after the highly efficient production of near-bandgap radiation was demonstrated.

37317 **(AD-A—190204/8/XAB) Short-wavelength lasers based on selective Auger processes and core-excited metastable levels. Final technical report, 19 September 1986-19 March 1987.** Harris, S.E.; Young, J.F. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Oct 1986. 47p. NTIS, PC A03/MF A01.

The goal of this program is to investigate, both theoretically and experimentally, new approaches to constructing XUV and soft x-ray lasers. At these short wavelengths, atomic spontaneous emission times are typically less than a nanosecond and, for levels that autoionize, are often less than a few picoseconds. It is technically very difficult to excite such levels directly to produce laser action in the way that is commonly done for visible-laser levels. Practical short-wavelength lasers will have a significant impact in many areas of critical national interest; applications include spectroscopy of surfaces, high-resolution lithography, microscopy, and holography. The realization of the great promise of such applications, however, depends on the properties and practicality of the lasers developed. Although there is a 20 year history of proposals for XUV and soft x-ray lasers, most approaches require very high pumping powers. The authors developed systems that can produce useful gain using only moderate input energies by combining the unique properties of particular atomic states with innovative experimental techniques. To date, gain was observed in two species: Xe at 108.9nm, and Zn at three lines around 133nm. Useful gains, exp(3.6), can be achieved with input energies of less than 1J, and small signal gains exceeding exp(40) were achieved using less than 4J input. In the latter case, an output energy of 20 micro J in a beam with 10-mrad divergence was measured at 108.9nm.

37318 **(AD-A—190744/3/XAB) Saturation of the Xe III 109-nm laser using traveling-wave laser-produced-plasma excitation.** Sher, M.H.; Macklin, J.J.; Young, J.F.; Harris, S.E. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Nov 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 12, No. 11, 891-893(Nov 1987).

Construction and operation of a 109-nm, photoionization-pumped, single-pass laser in Xe III are described. The laser is pumped by soft x rays emitted from a laser-produced plasma in a traveling-wave geometry. Using a 3.5-J, 300-psec, 1064-nm laser pump pulse, a small-signal gain coefficient of 4.4/cm and a total small-signal gain of exp(40) were measured. The laser is fully saturated and produces an output of 20 microJ in a beam with 10-mrad divergence.

37319 **(AD-A—190746/8/XAB) Diode-pumped solid-state laser oscillators for spectroscopic applications.** Byer, R.L.; Basu, S.; Fan, T.Y.; Kozlovsky, W.J.; Nabors, C.D. (Stanford Univ., CA (USA). Dept. of Applied Physics). 1987. 3p. NTIS, PC A02/MF A01.

Pub. in Laser Spectroscopy VIII, 416-419(1987).

Solid-state laser development has been paced by the improvement of pumping sources. The development of high-power, efficient, long-lived diode lasers promises a revolution in solid state laser technology.

37320 **(DOE/DP/40200—65-Vol.33) LLE [Laboratory for Laser Energetics] Review: Quarterly report, October-December 1987.** Kelly, J. (ed.). (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1987. Contract FC08-85DP40200. 60p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88008065/JAW.

This volume of the LLE Review, covering the period October-December 1987, contains descriptions of the implementation of distributed phase plates for improved irradiation uniformity and the implementation of a cryogenic target capability on the OMEGA facility. The section on advanced technology has reports on the design and optimization of recombination x-ray lasers and a near-infrared dichroic dye for use in both active and passive liquid-crystal devices. Finally, the activities of the National Laser Users Facility and the GDL and OMEGA laser facilities are summarized. The highlights of this issue are (1) Distributed phase plates, implemented on OMEGA, have made the target-plane illumination uniformity insensitive to near-field phase and intensity errors that previously produced hot spots on target. (2) An integrated system for producing, positioning, protecting, and documenting microballoons containing a frozen DT layer was put into operation on the OMEGA target chamber. (3) Recent modeling results using a new, explicit nonlocal treatment of the Doppler-enhanced escape probability of the resonance radiation has shown short-pulse illumination and cylindrical expansion to be very important for producing net gain in carbon recombination x-ray lasers. (4) A near-infrared-absorbing, liquid-crystalline dye has been shown to exhibit dichroic behavior in nematic liquid-crystal hosts. This dye has superior optical absorbance in the 1-μm-wavelength region and excellent solubility in nematic hosts. These properties make this dye/host combination particularly interesting for device applications such as blocking filters, shutters, and modulators for the near infrared.

37321 **(DOE/ER/13788—1) The chirped-pulse free-electron laser: Annual performance report, September 1987-April 1988.** Moore, G.T. (New Mexico Univ., Albuquerque (USA). Center for Advanced Studies). Apr 1988. Contract AC04-76DP00789. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009289/JAW.

A theoretical and numerical investigation is underway of pulsed free electron lasers in which there is a dependence of electron energy on the time of injection into the wiggler. The chirped FEL is investigated using an one-dimensional model, neglecting emittance. Diffraction is included only approximately by projection onto the fundamental Gaussian mode of a stable optical resonator. (LEW)

37322 **(PB—88-184312/XAB) New femtosecond laser source and three dimensional image treatment. Final report.** (Centre de Documentation de l'Armement (CEDOCAR), 75 - Paris (France). Direction des Recherches, Etudes et Techniques). 1985. 54p. (In French). NTIS, PC E04/MF E04.

The chief objective of the study was to provide a femtosecond laser source that combines the advantages of the passive and active systems previously called to mind. The hybrid system thus developed was carefully characterized, using an original method of temporal analysis of the pulses by crossed correlations. Parallel to the development of these sources with high temporal resolution, some applications relating to optical imagery with very high spatial resolution were accomplished. The length of the wave train of a luminous pulse of 50 fs corresponding to fifteen micrometers associated with techniques of nonlinear optics allows imagery at very high resolution. Experiments with two-dimensional imagery for a given side, as well as experiments of thickness measurement in transparent media are described briefly.

37323 **(PB—88-863808/XAB) Neodymium YAG (yttrium-aluminum-garnet) lasers. September 1983-May 1988 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for September 1983-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 126p. NTIS PC N01/MF N01.

Supersedes PB—87-859674.

This bibliography contains citations concerning the properties and applications of neodymium-yttrium-aluminum-garnet lasers. Applications include welding of parts such as printed circuits, medical applications, telecommunication systems, and optical pumping for high-powered lasers. (This updated bibliography contains 262 citations, 23 of which are new entries to the previous edition.)

37324 **(UCRL—96767) Initial electron distributions for free-electron lasers generated by injector and accelerator simulations.** Boyd, J.K.; Colson, W.B.; Scharlemann, E.T. (Lawrence Livermore National Lab., CA (USA); Berkeley Research Associates, Inc., CA (USA)). 16 Sep 1987. Contract W-7405-ENG-48. 17p. (CONF-8709110—21). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007022/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

Early free-electron laser (FEL) development was guided by simple performance criteria based on the number of undulator periods, electron beam quality, and current. The beam quality (emittance and energy spread) was used to characterize the initial distribution of axial electron velocities along the undulator axis. While the emittance and energy spread determine the overall width of the distribution, its detailed shape is also important. As new accelerators are designed specifically for FEL applications, it becomes important to obtain distribution shape information from simulations that include the electron gun, accelerator, and beam transport in addition to the usual electron/optical interaction in the undulator. The distribution at the entrance to the undulator can be calculated from numerical simulations of the cathode emission, acceleration, and transport of an electron beam. We have modeled the beam generation, from cathode emission up to the energy of the accelerator injector, using an axisymmetric, cylindrical geometry particle simulation (DPC). This code solves the relativistic force equation with fields obtained from Maxwell's equations in the Darwin model. The DPC calculation is run repeatedly varying parameters such as accelerating stress, electrode configuration, and axial magnetic field profile until a good match is obtained for the accelerator. The beam exiting from the injector can be accelerated and transported using the transfer matrix technique with a simple model for accelerating gaps and magnets. Alternatively, acceleration and transport can be simulated with a particle code that solves for the axisymmetric evolution of a slice of an electron beam including possible emittance growth. The phase space obtained from the accelerator can be evaluated for performance using either the simple FEL integral equation method or the more complete FRED simulation code. 9 refs., 5 figs.

37325 **(UCRL—97575) A new near-infrared tunable-room temperature solid state laser $La_3Ga_5SiO_{14}:Cr^{3+}$.** Lai, S.T.; Chai, B.H.T.; Long, M.; Shinn, M.D. (Allied-Signal, Inc., Morristown, NJ (USA); Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 2p. (CONF-871060—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011341/JAW.

From Topical meeting on tunable solid state lasers; Williamsburg, VA, USA (26 Oct 1987).

Laser action at room temperature has been achieved in $La_3Ga_5SiO_{14}$:Cr. The laser free running wavelength is 968 nm. The fluorescence quantum yield is 42% at room temperature. A large single crystal boule has been grown by the Czochralski method. 1 ref.

37326 **(UCRL—98068) High spatial frequency thermal blooming instability: A linear stability analysis.** Barnard, J.J. (Lawrence Livermore National Lab., CA (USA)). 29 Apr 1988. Contract W-7405-ENG-48. 24p. (CONF-8803106—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010711/JAW.

From Workshop on physics of directed energy propagation in the atmosphere; Las Cruces, NM, USA (29 Mar 1988).

The fine-scale thermal blooming instability is shown to be affected by the laser pulse length. In this study, we calculate the asymptotic gain of a sinusoidal perturbation as a function of pulse length and perturbation wave number. We include the effects of viscosity, diffusion, and wind shear, and we heuristically estimate the effect of turbulence. We find that for short laser pulses, the small wave number perturbations are reduced due to acoustic effects. However, large wave number perturbations remain large and extend to a higher cutoff in wave number than in the long laser pulse limit. At wave numbers higher than this cutoff, thermal diffusion causes exponential decay of the perturbations. For long laser pulse length wind shear and turbulence limit perturbation growth. 16 refs., 3 figs.

37327 **Configuration interaction calculation of the electronic spectra of $MgF_2:V^{+2}$.** Winter, N.W.; Pitzer, R.M. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Chemical Physics;* **89**: No. 1, 446-451(1 Jul 1988).

The ground and excited quartet states of divalent vanadium in a magnesium fluoride host have been determined from Hartree—Fock and configuration-interaction calculations. The potential energy curves for the symmetric stretch of the nearest-neighbor fluoride ions were determined and used to calculate the vibrational energy levels and wave functions. The ground-state absorption bandwidths were calculated from the Franck—Condon overlaps and compared to the experimental low-temperature spectra. The calculated vertical excited-state absorption energies from the first excited state are also found to be in good agreement with recent measurements.

37328 **Exalite 392E: a new laser dye for efficient cw operation between 373 and 408 nm.** Tully, F.P.; Durant J.L. Jr. (Sandia National Laboratories, Combustion Research Facility, Livermore, California 94550). *Applied Optics;* **27**: No. 11, 2096-2097(1 Jun 1988).

Exalite 392E is found to offer significant improvements in the preparation of dye solutions for efficient ultraviolet dye lasers./ AIP/.

37329 **Numerical simulations of the operation of an electron-beam pumped laser.** Sweeney, M.A.; Patterson, E.L.; Samlin, G.E. (Sandia National Labs. (US)). pp 26-27 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC04-76DP00789.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

HAWK, a 1-MV, 2-A, 1-ms electron-beam pumped laser facility, has been constructed to study the kinetics of reactor-driven gas lasers. A highly focused electron beam is injected from a vacuum region through a 4-mm-diameter fast opening valve into a narrow, 43-cm long, gas-filled drift region and then through a larger gate valve into the laser cell. The electron beam is laterally confined by an axial magnetic field. The authors describe numerical simulations of the electron-beam pumped system, obtained with the 3-D Monte Carlo electron-photon transport ACCEPTM code. The calculations include the effects of fringing magnetic fields on a nearly collimated beam at the cavity injection point and of fringing fields at the far end of the laser cell.

37330 **Opacity calculations for laser plasma applications.** Magee, N.H. Jr. pp 103-110 of Lasers '86; Proceedings of the Ninth International Conference on Lasers and Applications, Orlando, FL, Nov. 3-7, 1986. Mcmillan, R.W. Atlanta, GA; Georgia Institute of Technology (1987). (CONF-861177—).

From 9. international conference on lasers and applications; Orlando, FL, USA (3 Nov 1986).

Modifications introduced into the Los Alamos National Laboratory light-element detailed-configuration opacity code LEDCOP to improve its accuracy in determining absorption coefficients and group means for use in laser-plasma thermal-radiation transport calculations are described and demonstrated. Particular attention is given to the inclusion of complete internally consistent LS-term energies and oscillator strengths, the treatment of transitions at all wavelengths, and the use of more accurate photoionization cross sections for both ground and excited states. Sample results for Al, C, and O are presented graphically and shown to be in much better agreement with published experimental data than those calculated with previous codes. 5 references.

37331 **Power lasers.** Eloy, J.F. New York, NY; John Wiley and Sons Inc. (1987). 200p. John Wiley and Sons Inc., 605 Third Avenue, New York, NY 10150.

This book offers a review of laser-interaction phenomena including important recent advances in the field. The book details the physical properties of power lasers and the optical properties of solids subjected to high photon flux. Also provided is a study of power laser-material interaction, and applications such as the manufacture of thin layers, welding, laser recrystallization, and treatment and laser fusion.

37332 **Scaling analysis of x-ray lasers.** Garrison, J.C.; Chiao, R.Y. (Lawrence Livermore National Lab., Livermore, CA 94550 (US)). pp 66 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper TUGG 36.

The authors found that a scaling analysis maps propagative aspects of x-ray lasers onto other laser systems operating at longer wavelengths. One can then determine experimentally how the output coherence and directionality of the x-ray laser depend on the internal parameters and geometry of the laser. Certain dimensionless numbers, analogous to the Reynold's number in hydrodynamics, emerge from the scaling analysis.

37333 **Prospects for free-electron laser operation in the extreme ultraviolet.** Newnam, B.E. (Los Alamos National Lab., Chemistry and Laser Sciences Div., Los Alamos, NM 87545 (US)). pp 88 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper TUMM 1.

Continued progress by several research groups is increasing the near-term prospects for free-electron laser (FEL) operation into the extreme UV and soft x-ray regions. For wavelengths longer than 1 nm, these devices hold the promise of greatly exceeding the spectral brightness of the present generation of broadly tunable synchrotron light sources. The authors compare the salient features of the FEL oscillator and amplifier configurations which are under active study and development.

37334 **High-gain free-electron lasers: Characteristics and applications.** Kim, K.J. (Lawrence Berkeley Lab., Center for X-Ray Optics, Berkeley, CA 94720 (US)). pp 96 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper WAA 2.

In simple undulators, electrons, which are initially uncorrelated, remain essentially uncorrelated as the electron bunch moves through the undulator. The radiation emitted in this case, called the undulator radiation, is analogous to the spontaneous emission in atomic systems. As the number of undulator periods N increases, the cumulative effects of the radiation-electron beam interaction could lead to a density modulation in the electron beam and an exponential amplification of the undulator radiation. Undulators operating in this regime will be called the high-gain free-electron lasers (FELs). The radiation emitted in this case is called self-amplified spontaneous emission (SASE) by analogy with laser terminology. The high-gain FELs operating in the SASE mode do not require use of high-reflectivity mirrors to form optical cavities. Thus they are promising alternatives to the usual FELs as generators of intense coherent radiation at wavelengths shorter than 1000, A. High-gain FELs can also be used in an amplifier mode if coherent input radiation is available at the desired wavelengths. The coherence properties of the emitted radiation in this mode would be the same as those of the input. The authors studied the characteristics of the high-gain FELs starting from the Maxwell-Klimontovich equation. The use of a microscopic description of electrons, the Kilmontovich distribution function, is necessary to discuss how SASE emerges in long undulators. Also, their analysis is three-dimensional so that important issues such as guiding and transverse coherence can be clarified.

37335 **Physics issues for high-power free-electron laser amplifiers.** Scharlemann, E.T. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550 (US)). pp 96 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper WAA 3.

The FEL program at the Lawrence Livermore National Laboratory is examining the physics uncertainties of optical mode quality, optical guiding and wiggler focusing, and the technological problem of wiggler tolerances in the 10.6-μm Paladin experiment. The experiment and its predecessor Elf (at 35 GHz) are reviewed. Efforts to construct a tunable but very accurate electromagnetic wiggler with isochronous focusing are described. Expectations of optical beam quality, optical mode clean-up, and optical guiding are presented.

37336 **Preparation of certain m-aminophenols and the use thereof for preparation of laser dyes.** Hammond, P.R. (to Dept. of Energy, Washington, DC). US Patent 4,622,400. 11 Nov 1986. Filed date 29 Dec 1983. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

Methods are provided for making certain m-aminophenols using a sulfonation/alkali fusion procedure. The aminophenols are key intermediates in the synthesis of dyes, particularly efficient, stable dyes for laser application. Preparations of some rhodamine and phenoxazone dyes from the m-aminophenols are described.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 35736, 35857, 36007, 36021, 36146, 36201, 36208, 36209, 36452, 36720

37337 **(AD-A—190158/6/XAB) Observations on the use of the FTS (Filter Test System) 400. Technical note.** Coleman, J.R. (Defence Research Establishment, Ottawa, Ontario (Canada)). May 1987. 18p. (DREO-TN—87-19). NTIS, PC A03/MF A01.

This note contains remarks on the use of the FTS 400, a system designed by TSI Inc. to meet DREO requirements in filter testing. Production of Aerosol: In the range 0.01 - 0.30 micrometer diameter, polydisperse aerosols are produced by atomizing and drying solutions of sodium chloride in water or dioctyl phthalate in isopropanol. The electrostatic classifier selects a narrowly defined size in the range quoted above, which is then employed as the challenge. While the classifier is capable, operating as a standalone instrument, of selecting out particles as large as 1.0 micrometer, operational compromises in the FTS system, related probably to air flow through the classifier, limit the upper size to 0.31 micrometer. For particle size greater than 0.5 micrometers, the aerosol source is aqueous suspensions of monodisperse (very uniformly sized) polystyrene latex spheres (PSL), stored in the 9302 angstrom atomizers of Figure 1. A suspension is dried and diluted and passed through the test object. For reasons given below the APS and not the CNC must be used as the count instrument. Keyword: Canada.

37338 **(CEA-CONF—9240) Study and resolution of Riemann problem for two-phase flow models. Application for numeric diagrams type Godunov.** Toumi, I. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 6p. (In French). (CONF-8711192—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753462/JAW.

From 1. Maghrebin colloquium on numerical models for engineers; Alger, Algeria (22 Nov 1987).

In this paper the author presents a study of the Riemann problem for two-phase flow. The results have been used to construct two numerical scheme of Godunov type.

37339 **(CEA-CONF—9241) Tubular circuits optimization with respect to vibratory risks in flow.** Hassi, H.; Axisa, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 14p. (In French). (CONF-8711192—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753463/JAW.

From 1. Maghrebin colloquium on numerical models for engineers; Alger, Algeria (22 Nov 1987).

In this paper the authors describe the methods recently developed for optimization of industrial pipes with respect to vibratory risks. An example for an expansion bend in a hot temperature liquid transport circuit is given.

37340 **(CEA-CONF—9242) Tubes bundles vibrations in turbulent flow. Study by homogenization method.** Hammami, L.; Brochard, D.; Gibert, R.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 10p. (In French). (CONF-8711192—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753464/JAW.

From 1. Maghrebin colloquium on numerical models for engineers; Alger, Algeria (22 Nov 1987).

In this paper, the authors present an homogenization method for the study of tubes bundles in a turbulent flow. With this method the authors construct an equilibrium equation of homogeneous medium which permits the use of Inca code. Some results are shown.

37341 **(CLM-R—280) Multiphase flow simulations of shocks and detonations: Pt. 2. Detonations.** Thyagaraja, A.; Fletcher, D.F. (UKAEA Culham Lab., Abingdon). Oct 1987. 36p. (MFCIWP—87-P57). H.M. Stationery Office, London, price Pound 5.00.

In this paper we use the multiphase flow code CULDESAC to compute detonations in two-component mixtures. We present results showing the different types of detonations which are possible and illustrate the effect of varying the initial conditions and geometry, and changing the constitutive relations, on the form of the solution obtained. This work represents the first stage in the development of a multi-component model of the propagation stage of a steam explosion.

37342 **(CONF-880772—1) Laser/fluorescent dye flow visualization technique developed for system component thermal hydraulic studies.** Oras, J.J.; Kasza, K.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012008/JAW.

From 3. international symposium on refined flow modelling and turbulence measurements; Tokyo, Japan (26 Jul 1988).

A novel laser flow visualization technique is presented together with examples of its use in visualizing complex flow patterns and plans for its further development. This technique has been successfully used to study (1) the flow in a horizontal pipe subject to temperature transients, to view the formation and breakup of thermally stratified flow and to determine instantaneous velocity distributions in the same flow at various axial locations; (2) the discharge of a stratified pipe flow into a plenum exhibiting a periodic vortex pattern; and (3) the thermal-buoyancy-induced flow channeling on the shell side of a heat exchanger with glass tubes and shell. This application of the technique to heat exchangers is unique. The flow patterns deep within a large tube bundle can be studied under steady or transient conditions. This laser flow visualization technique constitutes a very powerful tool for studying single or multiphase flows in complex thermal system components.

37343 **(CONF-8803102—1) Pressure drop and heat transfer in turbulent non-Newtonian pipe flow of advanced energy transmission fluids.** Choi, U.S.; Liu, K.V.; Kasza, K.E. (Argonne National Lab., IL (USA). Materials and Components Technology Div.). 1988. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010021/JAW.

From International conference on advanced science and technology; Chicago, IL, USA (19 Mar 1988).

Argonne National Laboratory (ANL), under sponsorship of the US Department of Energy, is making significant progress on the development of advanced energy transmission fluids for thermal systems, in particular district heating and cooling systems. ANL has identified two concepts for developing advanced energy transmission fluids. Tests have been conducted at ANL to prove these concepts. This paper presents experimental results and discusses the degradation behavior of linear polymer additives and the flow and heat transfer characteristics of non-melting slurry flows. The experimental data obtained in this study provide support for the use of friction reducing additives and slurries in thermal system applications.

37344 **(DOE/ER/13398—9) Effects of surface tension and contact angle on sensible heating and boiling incipience in dielectric falling films.** Marsh, W.J.; Mudawwar, I. (Purdue Univ., Lafayette, IN (USA). Boiling and Two-Phase Flow Lab.). 1988. Contract FG02-85ER13398. 9p. (CONF-880744—1). NTIS, PC A02;3. Order Number DE88007057/JAW.

From Session on boiling phenomena in electronic equipment; Houston, TX, USA (1 Jul 1988).

Predicting the point of incipient boiling is of paramount importance for reliable operation of liquid-cooled microelectronic heat sources during power transients. This study focuses on heat transfer from a simulated multichip module to a falling film. Experiments have been performed to develop an understanding of the influence of surface tension and wetting characteristics in sensible heat transfer and boiling incipience in free-falling dielectric (FC-72) liquid films. A correlation for the space-average heat transfer coefficient is presented which shows clear departure of FC-72 data from correlations obtained for fluids with higher surface tension. The boiling results reveal that the vanishingly small contact angle of FC-72 precluded the application of correlations currently employed to predict incipience. Also, the temperature overshoot commonly encountered upon boiling incipience in wetting fluids was nonexistent in all the experimental runs. 14 refs., 12 figs.

37345 **(IKE—2-77) Investigation of triggered interactions at one or several hot tin melt droplets in water.** Froehlich, G.; Hauk, G. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Apr 1986. 121p. (In German). Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme.

Hot molten tin drops were injected into a vessel filled with water and ignited to an explosive interaction by an underwater bridge wire explosion. From high speed pictures (by spark camera) the time of the beginning of the interaction after shock wave triggering and times of the special expansion stages of the cyclic interactions were determined. Fragment analysises show an increase of the specific fragment surface at higher trigger pressures. The interaction histories of simultaneously triggered drops were compared. Results show that only the timing of the trigger but also small individual differences in drop parameters influence essentially the begin of an explosive drop interaction.

37346 **(JINR—R-8-87-505) Mass flow rate influence on void fraction of two-phase helium flow.** Ko Gym Sek; Mamedov, I.S.; Filippov, Yu.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702456/JAW.

Based on the minimum entropy production principle an analysis of mass flow rate influence on void fraction of two-phase adiabatic flows is made. The friction factor role and fraction of liquid entrained into vapour steam ones are demonstrated. The results of helium two-phase flow calculations as well as the comparison with analogous reference data are presented. The engineering calculation technique for void fraction of helium two-phase flows is suggested. 19 refs.; 4 figs.

37347 **(JINR-R—8-87-446) Hydrodynamical characteristics of helium two-phase flows at relatively high mass rates.** Son Zun Gan; Selyunin, S.Yu.; Filippov, Yu.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702936/JAW.

Submitted to the journal Teploehnergetika.

Theoretical model is proposed for the pressure drop of channels through which the two-phase flow of helium with relatively high mass flow rates moves. With the help of this model the region of hydraulic crysis is predicted. Experimental results which are consistents with the theoretical model predictions are presented. It is shown that under certain conditions the hydrodynamical characteristics of helium two-phase flows and of steam-water ones are analogous and that the existence of some distinctions are caused by the difference in thermophysical properties of helium and water. The data obtained are compared with the results available in literature. 21 refs.; 3 figs.

37348 **(K/SS—504) Rupture testing of UF_6 transport and storage cylinders.** Ziehlke, K.T.; Barlow, C.R. (Martin Marietta Aerospace, Orlando, FL (USA). Missiles and Electronics Group; Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1988. Contract AC05-84OT21400. 2p. (CONF-880558—10; CONF-880558—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010425/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

Rupture tests have been conducted on pressure vessels of all sizes and designs in current commercial use in the transport and storage of uranium hexafluoride. The test results have demonstrated the general conformance of the cylinders to their design criteria. Several of the test cylinders were taken from active service. A few were made available as the result of handling mishaps: These were a dented 48-inch cylinder and two type 30B cylinders damaged in a warehouse fire. The tests have shown that the stiffening ring butt weld serves to localize the failure of the 48-inch cylinders, with an associated penalty in ultimate pressure. They have also shown the extreme conservation of design in the case of the 5-inch cylinder, the only product cylinder qualified for 100% enriched material. Finally, they have shown a basic tendency toward brittle fracture in over-pressuring of the DOT-qualified type 30A cylinder, resulting in a recommendation for discontinuation of its use as a transport cylinder.

37349 **(PB—88-182449/XAB) Literature survey of slug flow.** Pauchon, C. (SINTEF, Trondheim (Norway)). 8 Dec 1987. 91p. (STF—11-A87070). NTIS, PC E05/MF E05.

A review of the various aspects of slug-flow modeling is presented in an attempt to highlight the governing parameters and their interdependence. With the aim of providing important information that could serve as a basis for future modeling work in the area, attention is focused on the characteristics of the various models, and on aspects that need careful consideration with regard to extrapolation to large-scale systems.

37350 **(PB—88-182456/XAB) Terrain slugging phenomena. Some experimental results obtained at the SINTEF Two-Phase Flow Laboratory.** Linga, H. (SINTEF, Trondheim (Norway)). 8 Nov 1987. 21p. (STF—11-A87049). NTIS, PC E03/MF E03.

An experimental study of the topography influence on terrain slugging was performed. A bump is introduced in the horizontal line upstream of a line-riser low-point. This causes the terrain-slugging region to be significantly enlarged. Also the upper pressure limit for terrain slugging is increased from some 60 bar to 75 bar. The experimental observations clearly demonstrate that terrain slugging is a strongly system-dependent phenomenon.

37351 **(PB—88-182464/XAB) Applicability of the shear stress device K-tube in two-phase flow.** Onarud, G. (SINTEF, Trondheim (Norway)). 1 Jun 1987. 50p. (STF—11-A87037). NTIS, PC E04/MF E04.

The shear stress measuring device K-tube has been tested for accuracy and applicability in horizontal two-phase flow in a 24-mm pipe at atmospheric pressure. If the hole diameter is too big compared to the film thickness the film will be subjected to a too high degree of disturbance and hence affect the measurements one way or the other. In order to establish an acceptable hole diameter, several different K-tubes were tested with hole diameters varying from 0.4 to 4.0 mm. The investigation has confirmed that the K-tube is applicable in two-phase flow if some precautions are taken.

37352 **(RISO-M—2641) Computer model simulation of two-phase flow instability in a full-scale pipeline-riser system.** Rathmann, O.; Iversen, S. (Lic Consult Raadgivende Ingenioerer A/S, Copenhagen (Denmark); Risoe National Lab., Roskilde (Denmark)). May 1987. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752806/JAW.

The onset of two-phase flow instability (severe slugging) in an existing full-scale pipeline-riser system, for which observations of severe slugging exist, has been simulated by the computer models MULTWO and LICTWOP. The models contain submodels for most relevant flow patterns (e.g. horizontal/inclined stratified flow and vertical slug flow), by which a fine agreement with the measured steady state data can be obtained. No ad-hoc models for severe slugging were added. Both the numerical simulations with the computer models and separate analytical studies stress the importance of a proper numerical representation of wave propagation phenomena for a reliable prediction of severe slugging. 10 refs.

37353 **A numerical study of transient conjugate natural convection in an enclosed stratified fluid.** Gopalakrishna, S.; Himasekhar, K.; Lior, N. (Univ. of Pennsylvania, Dept. of Mechanical Engineering and Applied Mechanics, Philadelphia, PA (US)). pp 177-182 of Heat transfer: Pittsburgh 1987. Lyczkowski, R.W. New York, NY; American Institute of Chemieal Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The objective of this study is to determine the effect of heat transfer in the walls of a container on natural convection in the enclosure filled with an initially-stable stratified fluid. A two-dimensional wallfluid transient conjugate heat transfer problem in an enclosure with the top and bottom walls insulated is solved numerically for Rayleigh numbers of 6.7×10^7, 6.7×10^8 and 6.7×10^9 with Pr=6.7, Bi=0 and 0.02, and for three different wall materials. A stratification index, S, is proposed and evaluated: it decreases sharply with increasing Rayleigh number and wall thermal diffusivity in contrast to the case of a perfectly insulating wall.

37354 **Proton-coupled transport of alkali metal cations across liquid membranes by ionizable crown ethers.** Bartsch, R.A.; Charewicz, W.A.; Kang, S.I.; Walkowiak, W. (Dept. of Chemistry and Biochemistry, Texas Tech Univ., Lubbock, TX (US)). pp 86-97 of Liquid membranes: Theory and applications. Noble, R.D.; Way, J.D. Washington, DC; American Chemical Society (1987). (CONF-860645—).

From 8. Rocky Mountain regional meeting of the American Chemical Society: liquid membranes - theory and applications; Denver, CO, USA (8 Jun 1986).

Crown ether carboxyl acids and phosphonic acid monoalkyl esters are novel reagents for the active transport of alkali metal cations across organic liquid membranes. Metal ion transport is coupled to the back transport of protons. The influence of structural variation within the ionizable crown ether carrier molecule upon the selectivity and efficiency of competitive alkali metal transport across bulk liquid, liquid surfactant (emulsion), and polymer-supported liquid membranes is assessed.

37355 **Hydrogen sulfide facilitated transport in perfluorosulfonic acid membranes.** Way, J.D.; Noble, R.D. (National Bureau of Standards, Center for Chemical Engineering, Boulder, CO (US)). pp 123-137 of Liquid membranes: Theory and applications. Noble, R.D.; Way, J.D. Washington, DC; American Chemical Society (1987). (CONF-860645—).

From 8. Rocky Mountain regional meeting of the American Chemical Society: liquid membranes - theory and applications; Denver, CO, USA (8 Jun 1986).

Hydrogen sulfide and methane fluxes were measured at ambient conditions for 200 μm perfluorosulfonic acid cation exchange membranes containing monopositive EDA counterions as carriers. Facilitation factors up to 26.4 and separation factors for H_2SCH_4 up to 1200 were observed. The H_2S transport is diffusion limited. The data are well represented by a simplified reaction equilibrium model. Model predictions indicate that H_2S facilitated transport would be diffusion limited even at a membrane thickness of 1 μm.

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REFER ALSO TO CITATION(S) 35664, 35902, 36214, 36363, 36683, 36729, 36769, 36786, 36798, 37596, 37603

37356 **(AD-A—190235/2/XAB) Computational model for armor penetration. Annual report No. 2, October 1979-October 1980.** Erlich, D.C.; Seaman, L.; Curran, D.R.; Shockey, D.A.; Caligiuri, R.D. (SRI International, Menlo Park, CA (USA)). Oct 1987. 218p. NTIS, PC A10/MF A01.

Results are reported from the second year of a three-year BRL/AMMRC/SRI program to develop a computational capability for predicting the behind-the-armor fragment environment for spaced armor attacked by long-rod penetrators. The baseline materials chosen were rolled homogenous steel armor (RHA) and depleted uranium (DU) for the penetrator. Phenomenological studies involving both quarter and full-scale ballistics tests at velocities up to 1.5 km/s and obliquities from 0 to 70 clearly revealed shear banding to be the principal phenomenon controlling both penetrator erosion and armor failure. A detailed, phenomenological scenario for oblique armor penetration is given . Contained fragmenting cylinder (CFC) experiments were performed to characterize the resistance of RHA to shear banding; a significant anisotropy was observed. The SHEAR3 computational model for shear banding was refined and calibrated with respect to previously obtained data from CFC experiments using 4340 steel (Rc40).

37357 **(BFR-R—111-1986) Development and evaluation of selective coatings for window.** Ribbing, C.G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 58p. (In Swedish). NTIS (US Sales Only), PC A04. Order Number DE88752906/JAW.

Selective coatings intended for energy efficient windows have been studied on laboratory scale. The study mainly related to preparation of coatings of tin oxide, silver and titanium nitride and measurement of the optical properties of these, but commercially available coatings have also been investigated with regard to degradation mechanisms, and calculations of energy saving effect have been made. Different dopants have been tested as well as an alternative technique in which the dopants are directly added to the aerosol. Highest selectivity is obtained when ammonium fluoride is used as the dopant. Thin silverfilms which were magnetronsputtered at low pressure exhibited a significantly higher selectivity depending on improved homogeneity. The previously predicted selectivity of thin films of titanium nitride has been verified. The IR reflectivity of thin films has been enhanced by sputtering onto a heated glass substrate. Calculations show that the almost neutral color of these coatings can be precisely controlled by additions of minute amounts of carbon. In this context, color coordinate calculations were made for commercially available coatings under solar transmission conditions. The energy gains for an argon filled selective double glazed window, in comparison with an ordinary double glazed window, were found to be approximately 150 kWh per m/sb2/ per annum. The savings is clearly greater than what can be achieved by using a triple glazed window.

37358 **(BMU—1987-148) Experimental study on the application of noise emission analysis in pressure testing of a reactor pressure vessel. Final report.** Eisenblaetter, J. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). Sep 1986. 104p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The object of the investigations was the large containment of the MPA Stuttgart, a BWR pressure vessel, which is prepared with a large number of faults in welds and in the basic material. Six pressure tests up to the working pressure of a Boiling Water Reactor (71 bar) were carried out. Apart from the global multi-channel location technique, local supervisory methods were also used. The proof of a large number of different indications next to each other was possible with global location. The known faults did not, however, all emit to the expected extent. On the other hand, faults not previously known on some welds were shown to the testers; these indications were confirmed by subsequent non-destructive tests. An improvement in accuracy of location in local location by a factor of 20-30 using signal analysis, was demonstrated compared to global location.

37359 **(CONF-8805132—5) HPM coupling into realistic targets.** Bacon, L.D.; Aurand, J.F.; Toth, R.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011788/JAW.

From 4. national high power microwave conference; Monterey, CA, USA (9 May 1988).

High-Power Microwave coupling into targets of interest is extremely difficult to assess analytically or numerically. The practicalities of accurately modeling physical structures, as well as the subtlety of determining which simplifications are allowable for the accuracy needed, require that target interaction calculations be verified by careful laboratory measurements. In addition, the differ-

ences in construction techniques and tolerances on joints and seams make an experimental scan of the parameter space essential if we are to establish rules-of-thumb for coupling into systems. To meet this need for a benchmark for HPM coupling calculations, we have designed and constructed several RF shielding enclosures with generic but realistic joints and seams. We measured the coupling of RF into these enclosures over the frequency range of 45 MHz to 18 GHz, recording both amplitude and phase information. These data allow us to evaluate the response of various ports-of-entry to both continuous wave and pulsed sources. We can see trends with frequency for various port of entry types that relate to relatively simple geometric factors. This paper outlines what these results for generic targets imply for HPM coupling to real systems.

37360 **(CONF-8806121—1) Workshops and problems for benchmarking eddy current codes.** Turner, L.R.; Davey, K.; Ida, N.; Rodger, D.; Kameari, A.; Bossavit, A.; Emson, C.R.I. (Argonne National Lab., IL (USA); Georgia Inst. of Tech., Atlanta (USA); Akron Univ., OH (USA); Mitsubishi Atomic Power Industries, Inc., Tokyo (Japan); Electricite de France, 92 - Clamart; Rutherford Appleton Lab., Chilton (UK)). Feb 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009996/JAW.

From International symposium on fusion nuclear technology (ISFNT); Tokyo, Japan (10 Jun 1988).

A series of six workshops was held to compare eddy current codes, using six benchmark problems. The problems include transient and steady-state ac magnetic fields, close and far boundary conditions, magnetic and non-magnetic materials. All the problems are based either on experiments or on geometries that can be solved analytically. The workshops and solutions to the problems are described. Results show that many different methods and formulations give satisfactory solutions, and that in many cases reduced dimensionality or coarse discretization can give acceptable results while reducing the computer time required. 13 refs., 1 tab.

37361 **(DOE/ER/45315—1) The effects of gradients on boundary stability: Progress report, 1 July 1987-31 March 1988.** Hackney, S.A.; Plichta, M.R.; Lee, J.K. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1988. Contract FG02-87ER45315. 21p. NTIS, PC A03/MF A01;3. Order Number DE88009592/JAW.

This report discusses effects that will change grain boundary stability. In particular, morphological transitions and thermotransport induced grain boundary migration are briefly mentioned. 7 figs. (LSP)

37362 **(EPRI-NP—5834) Nondestructive examination of welds through painted surfaces: Final report.** Cook, J.F.; Holm, J.A.; Lassahn, G.D. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1988. Contract AC07-76ID01570. 92p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011428/JAW.

A study was performed to develop reliable nondestructive examination techniques for detection of surface-open defects located under a surface coating on ferromagnetic materials. The magnetic particle test method (MT) alternating current (ac) yoke technique presently appears to be an optimum approach because of its technically straight-forward operational basis. A complementary technique uses the eddy current method with a differential type probe. The techniques were verified on both cracked samples and artificial flaws through varying thicknesses of real and simulated coatings. An analytical study of the MT yoke technique, experimental details and test data are presented. On the basis of the test results, recommended changes to ASME Section XI requirements are identified for consideration.

37363 **(INIS-BR—1080) Radioactivity as a means of nondestructive testing.** Wagh, A.S.; Pinnock, W. (West Indies Univ., Mona (Jamaica). Dept. of Chemistry). 1986. 18p. (CONF-8609282—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702778/JAW.

From 1. non destructive testing congress for Latin America and Caribbean; Sao Paulo, Brazil (21 Sep 1986).

An attempt is made to develop a method in which certain solutions with radioactive solutes can be used as liquid penetrants. The gamma activity can be measured using a conventional counter. This activity gives a measure of the quantity of the penetrated fluid and an assessment of the depth and size of the flaw can be determined. We discuss two cases. a) The use of external penetrants and b) the use of inherent activity in the material. The first case is applicable in metallurgy while the second case is applicable to building material. The experimental arrangements will be discussed and critical comparisons with other methods will be done. The limitations of the method due to occupational health aspects will also be discussed.

37364 **(INIS-BR—1081) Reduced program of inspection by induced currents for condenser of Embalse nuclear power plant.** Obrutsky, L.; Mendonca, H. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1986. 14p. (In Spanish). (CONF-8609282—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702779/JAW.

From 1. non destructive testing congress for Latin America and Caribbean; Sao Paulo, Brazil (21 Sep 1986).

In this work it's presented a reduced inspection in service program by the technique of induced currents to the turbine condenser of Embalse's Power Plant (Cordoba). The authors based its elaboration on the results obtained in the exam of a small number of tubes and on experience obtained through four inspections in the condensers of Atucha I Power Plant, through mathematical models of oxygen and ammoniac distribution in both Power Plants, and its experimental verification in the case of Atucha I. This program improves the quality of inspection thereby reducing time, equipment and personnel employed. (C.M.).

37365 **(SAND—88-0068C) Gaseous tracer techniques for pore structure characterization of granular materials.** Erickson, K. L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880750—7). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011542/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

The pore structure of granular materials influences several physical and chemical phenomena, including: 1) heat and mass transfer rates, 2) fluid dynamics, 3) mechanical response, and 4) heterogeneous chemical reaction rates. In many systems, these phenomena are coupled, and accurate pore structure characterization is important to developing reliable predictive models. Gaseous tracer techniques show promise as a rapid nondestructive method for characterizing pore structures. To provide a basis for developing a theoretical and experimental approach involving multiple tracer techniques, five characteristic parameters were defined to describe the major features of a macroscopically uniform pore structure. Those parameters are the following: 1) the portion of the total pore space that forms flow paths (flow porosity), 2) the fraction that forms relatively stagnant paths (stagnant porosity), 3) the tortuosity of the flow porosity, 4) the specific surface area of the pore space, and 5) the fraction of the specific surface area that is associated with the flow porosity. Initial experiments with samples having simple, known pore structures were conducted to evaluate the theory and experimental techniques. Agreement between known and experimentally determined parameter values was good. Furthermore, it appears that the tracer techniques can have broad application as nondestructive diagnostic tools for examining granular materials.

37366 **(SAND—88-0460) Trafficability probe testing in sand and clay targets.** Foster, A.D.; Young, E.R.; Gillings, K.K. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 131p. NTIS, PC A07;3. Order Number DE88010974/JAW.

In September 1981, a series of tests were conducted at the Marine Base, Camp Pendleton, California, using an air gun to launch instrumented penetrators into sand and clay targets. The purpose of the tests was to collect penetrator deceleration and structural response data along with soil information and to assess the feasibility of establishing the type and strength of the soil encountered from the measured data. 6 refs., 43 figs., 16 tabs.

37367 **(SAND—88-0825) Development of a biaxial test system for thin-walled metal tubes using tensile-compressive axial load and internal-external pressure.** Schmale, D.T.; Bourcier, R.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011279/JAW.

A biaxial deformation test system has been developed to perform tensile-compressive axial loading and internal-external pressurization of thin-walled metal tubes. The system has been added to an existing MTS 490 kN load frame with a PDP 11/34 based computer control system. It consists of: (a) specimen grips, (b) high pressure chamber, (c) a hydraulic intensifier and controller and (d) associated valving and switching. Software has been written in the MTS MultiUser-BASIC language to perform simple multiaxial cyclic deformation of a tubular specimen. The design of the mechanical test system and software are described and preliminary test results for the deformation of 316 stainless steel tubing under various proportional loading paths are presented. 19 refs., 14 figs.

37368 **(STEV-FVE—87-8) Culverts for district heating with directly applied polyurethane insulation. Thermal stability of structures.** Jarfelt, U. (Statens Energiverk, Stockholm (Sweden)). Sep 1987. 161p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752961/JAW.

Testing equipment and methods have been developed for laboratory tests of polyurethane culverts. Heat losses can be determined as regards ageing and temperature levels. The equipment is described and a number of thermal insulation capacities of culverts have been determined. (G.B.).

37369 **(Y/DW—741) NDE performance in predicting failure strength of spherical composite specimens with implanted flaws.** Brosey, W.D.; Calfee, M.T.; Whittaker, J.W.; Henneke, E.G.; Post, D.; Reifsnider, K.L.; Blake, R.A. (Oak Ridge Y-12 Plant, TN (USA); Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Delaware Univ., Newark (USA)). 8 Feb 1988. Contract AC05-84OR21400. 21p. (CONF-880487—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008223/JAW.

From American Society of Nondestructive Testing (ASNT) spring conference; Orlando, FL, USA (11 Apr 1988).

The results of a program to evaluate nondestructive inspection techniques on spherical composite specimens are presented. Seventy Kevlar-epoxy filament wound specimens were made such that ten of the specimens contained one of seven defect conditions which simulated manufacturing or handling defects. These defect conditions were a standard no-defect condition, Teflon-shim simulated delamination, ceramic bead simulated voids, 10% low-fiber alternate winding pattern, low-modulus alternate fiber type, variable tension, and dry (low-matrix) fiber. Some specimens were impact damaged by dropping them from various heights to a hard surface. Each specimen was inspected using a variety of nondestructive techniques to determine which methods were useful for detecting the defect conditions in the specimens. These techniques included combinations of A, B, and C-scan ultrasonics, acousto-ultrasonics, x-ray CAT scans, radiography, thermography, optical stress coating, and acoustic emission. The specimens were subsequently pressurized to failure to determine any detrimental effect the implanted flaw types might have on enclosed geometry structures. One important finding in the study was that nominal defects introduced during the manufacturing or handling process do not significantly reduce the ultimate burst strength of the composite material in this geometry when creep and fatigue mechanisms are insignificant. 11 refs., 12 figs.

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REFER ALSO TO CITATION(S) 36005, 36181, 36454, 36897, 36921, 36938, 36983, 36984, 36985, 37263, 37286, 37359, 37587, 37589, 37620, 39041

37370 **(AD-A—190032/3/XAB) Rapid feature extraction via the Radon Transform. Final report, 1 October 1985-1 December 1987.** Gmitro, A.F.; Gindi, G.R. (Yale Univ., New Haven, CT (USA)). 1 Feb 1988. 33p. NTIS, PC A03/MF A01.

The investigators explored the area of neural-net associative memories and their optical implementations. The problem of organizing an associative memory to reflect known structure in the pattern is addressed; because the structure is encoded as a model in the memory, the memory differs considerably from simple pattern matchers where an iconic version of the pattern is stored. Early work concentrated on the idea of encoding a compositional hierarchy within the memory. Though this worked well, the theory was inadequate to explain the behavior of the memory. An optimization approach was adopted in which the goal of the computation could be stated in a mathematical objective function. The ideas of compositional and inheritance hierarchies were encoded directly into the objective function. A simulator was completed that demonstrated these ideas. Optical implementation was concerned with the problem of implementing ever more general interconnect patterns. The investigators began with the construction of a system that computed Radon Transforms of the input object. This demonstrated the necessary first step of an optical-connection scheme to transform objects to parameter spaces. A more complex system was built that demonstrated discrete space-invariant connection patterns. This worked satisfactorily. The current work involves designs for holographic space-variant connection patterns.

37371 **(AD-A—190129/7/XAB) Fundamental properties and devices applications of Ge(x)Si(1-x)/Si superlattices. Technical report, 1 August 1985-31 July 1987.** Wang, K.L. (California Univ., Los Angeles (USA)). 1987. 49p. NTIS, PC A03/MF A01.

The progress include (a) growth and characterization of Ge(x)Si(1-x)/Si epitaxial films and superlattices, (b) study of power loss by two dimensional holes in coherently strained Ge(x)Si(1-x)/Si heterostructures, (c) theoretical prediction of resonances of intraband absorption (d) study of B_2O_3 as a low temperature p-type dopant. Initial stage of growth of Ge(x)Si(1-x)/Si films were studied using reflection high-energy electron diffraction (RHEED) and the superlattice structures were characterized using TEM. In the study of magnetotransport of holes in Ge(x)Si(1-x)/Si SLS's, it was found that the power-loss data can be well understood by taking into account the effects from the acoustic mode phonons by both the deformation potential and the piezoelectric coupling. The resonance nature of intraband absorption can be used for sensitive and tunable IR-detector applications. The possibility of using B_2O_3 as an effective p-type doping source is demonstrated for providing abrupt doping profiles needed for GE(x)Si(1-x)/Si superlattices.

37372 **(AD-A—190169/3/XAB) High-density ion-implanted contiguous-disk-bubble technology. Annual Scientific Report No. 1, 30 September 1986-29 September 1987.** Kryder, M.H.; Greve, D.W.; Guzman, A.; Jo, S.C.; Ramesh, M. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Electrical and Computer Engineering). 31 Oct 1987. 267p. NTIS, PC A12/MF A01.

During the past year the authors advanced the state-of-the-art in several areas of magnetic-bubble technology. The main thrust of their research was to advance ion-implanted contiguous disk devices because these devices offer order-of-magnitude higher bit density than presently manufactured bubble devices. Noteworthy accomplishments include demonstration of bubble propagation in devices having 4 sq micrometer bit cells and exhibiting operating margins equal to those of today's manufactured devices. These devices were demonstrated to operate from 0 to 120 C, the limits of the testing capabilities. A major factor in this success was development of new epitaxial garnet materials that exhibited isotropic magnetostrictive properties -- a feature previously not obtained. In addition to the work on bubble propagation, significant progress was made

on demonstrating a fully operational contiguous-disk chip, complete with bubble generators, transfer gates and stretcher/detectors. All components have been demonstrated to operate with good overlapping margins, and a complete chip was designed and fabricated.

37373 **(AD-A—190223/8/XAB) Real-time stressed-channel simulator. Final report.** (TCS, Inc., San Diego, CA (USA)). 10 Dec 1987. 74p. (TCS-TP—87-059). NTIS, PC A04/MF A01.

The Strategic Defense Initiative (SDI) research efforts are directed at a number of system-architecture options involving space, airborne, and terrestrial platforms. A major consideration in the system architecture is the resolution of the battle management (BM) concept. To resolve the many complex issues, the Strategic Defense Initiative Organization (SDIO) has recognized the need for communication, command, and control (C3) data links between the various platforms. The link or communication-channel conditions are relatively benign during peacetime; however, in wartime situations, during pre-, trans-, and post-attack periods, the channel conditions degrade rapidly causing severe disruptions in C3. The approaches to battle management, as they are tailored to the various architecture options being considered, will depend heavily upon the communications-link integrity. This research is significant and timely in that it relates to the National Test Bed (NTB), in support of the SDI full-state development decision process. The NTB program is presently being undertaken by major contractors and involves the design, development, and installation of both experimental and simulation capabilities to form the NTB. This Phase I research effort takes a major step in configuring a Real-Time Stressed Channel Simulator (RTSCS) to evaluate BM/C3 concepts for the SDI program.

37374 **(AD-A—190678/3/XAB) Implementation and performance analysis of parallel assignment algorithms on a hypercube computer. Master's thesis.** Carpenter, B.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 165p. (AFIT/GCE/ENG—87-2). NTIS, PC A08/MF A01.

The process of effectively coordinating and controlling resources during a military engagement is known as Battle Management/ Command, Control, and Communications (BM/C3). One key task of BM/C3 is allocating weapons to destroy targets. The focus of this research is on developing parallel methods to achieve fast and cost-effective assignment of weapons to targets. Using the sequential Hungarian method for solving the assignment problem as a basis, this report presents the development and relative performance comparison of four parallel assignment algorithms implemented on the Intel IPSC hypercube computer. The first approach partitions the problem space into smaller, independent subproblems and assigns each to a processing node in the hypercube. The second and third approaches also partition the problem space, but they assign each partition to a group of processing nodes. Each group is controlled by a separate node which further subdivides the partition among members of the group. In the second approach, the control node acts as an arbitrator to eliminate the redundant assignment of weapons to targets by idling redundantly allocated weapons. The third approach eliminates redundant weapon allocations by selecting the least-costly redundant allocations and directing additional processing to reallocate the more-costly weapons. The fourth approach is a parallel implementation of the Hungarian algorithm, where certain subtasks are performed in parallel. This approach produces an optimal assignment instead of the sub-optimal assignment generally obtained using either of the three heuristic approaches.

37375 **(AD-A—190745/0/XAB) Second-harmonic generation of a continuous-wave diode-pumped Nd:YAG laser using an externally resonant cavity.** Kozlovsky, W.J.; Nabors, C.D.; Byer, R.L. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Dec 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 12, No. 12, 1014-1016(Dec 1987).

The authors report 13% second-harmonic conversion efficiency of a 15-mW, c-w, diode laser-pumped Nd: YAG oscillator. 2 mW of single-axial-mode 532-nm radiation was generated by externally resonant second-harmonic generation in a monolithic MgO-doped lithium niobate nonlinear crystal cavity. The measured finesse of 450 for the monolithic external cavity indicated that absorption and scatter losses in the doubler were less than 0.8%.

37376 **(CONF-880701—2) Experimental determination of the effects of steep front-short duration surges on 25 kVA pole mounted distribution transformers.** Eichler, C.H.; Legro, J.R.; Barnes, P.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.; Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009056/JAW.

From IEEE Power Engineering Society summer meeting; Portland, OR, USA (24 Jul 1988).

Nineteen standard commercial, 7200-volt, 25-kVa distribution transformers were tested to determine vulnerability of their insulation systems to steep front-short duration (SFSD) surges. These transformers were tested both with and without surge arresters using the high voltage pulser at the Maxwell Laboratories, San Diego, CA. The open circuit pulser test voltages were 400 kV, 500 kV, 800kV, and 1000kV. These voltages exhibited an approximately 60 ns rise time and aproximately 2000 ns to half value. The voltage was applied to the transformer under test through a 400-Ohm series resistor. This series resistor represented the distribution line surge impedance. Standard lightning impulse tests for this voltage class of distribution transformers were conducted prior to the steep front surge tests to verify insulation integrity, and were repeated following the steep-front surge tests to ascertain if an insulation failure had occurred in the tested transformer due to the steep-front impulse. Failed transformers were disassembled to evaluate failure modes. It was determined that no insulation failures occurred on any transformers tested that were protected by surge arresters mounted directly on the transformer. An external flashover of the high voltage bushing occurred in some cases when the transformer was not protected by a surge arrester, but the bushing sparkover was not always sufficient to protect the transformer. Unprotected transformers failed at voltages around 250 kV to 300 kV peak. The failure mode was usually an internal flashover/puncture between the first few turns of the outer layer of the high voltage winding and the low voltage winding or, sometimes, to an inner layer of the high voltage winding. 10 refs., 10 figs., 1 tab.

37377 **(LA—11243-MS) Chip cooling concepts: Combined groundplane and coldplate.** Bennett, G.A.; Hedstrom, J.C. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 32p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009576/JAW.

Careful thermal design is essential for realizing improvements in power density and efficiency of high-power microwave transistor amplifiers. A systematic study of a nonconventional microwave power amplifier module component is made to quantify its thermal behavior and to identify specific changes that would reduce thermal resistance. These improvements would lead to more compact, lighter-weight, and higher-power density designs for microwave power systems. Improvements in radio-frequency (RF) amplifiers begin with enhancements in the performance of the transistor building block. Previous work defined thermally optimum package materials and geometry using the conventional transistor package components. Further improvements in thermal performance, beyond the package, can be obtained by modifying the conventional cooling system geometry that includes a transistor, mounted to a groundplane, and a circuit board. These are both then mounted on a coldplate. This report describes the results of the analyses of a nonconventional amplifier module and cooling system. Results of the analyses are shown as a series of tables and in plots of temperature vs time and in isotherm contour plots. 20 refs., 25 figs., 5 tabs.

37378 **(LA-UR—88-1070) Recent advances in high-power microwave amplifiers.** Reid, D.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 4p. (CONF-880565—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007820/JAW.

From IEEE MTT-S international microwave symposium; New York, NY, USA (25 May 1988).

Recent advances in microwave amplifiers have increased efficiencies and power levels at frequencies from 0.3–150 GHz. These improvements have occurred in both solid-state and vacuum-tube systems. Of special note is the very high power device where power levels of 1 GW are routinely generated. This paper will review the latest results of these R&D efforts. 3 refs., 4 figs.

37379 **(LBL—21546) Preliminary measurements of gamma ray effects on characteristics of broad-band GaAs field-effect transistor preamplifiers.** Jackson, H.G.; Shimizu, T.T.; Leskovar, B. (Lawrence Berkeley Lab., CA (USA)). Jan 1985. Contract AC03-76SF00098. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number TI88008417/JAW.

The effect of gamma radiation on electrical characteristics of cryogenically cooled broad-band low-noise microwave preamplifiers has been preliminarily evaluated. The change in the gain and noise figure of a 1-2 GHz preamplifier using GaAs microwave transistors was determined at gamma doses between 10^5 rad to 5 {times} 10^6 rad. The gain and noise figure was measured at ambient temperatures of 300 K and 80 K. 8 refs., 2 figs.

37380 **(LBL—24799) Effects of near interfacial microstructure on toughness and subcritical crack growth in ceramic/metal systems.** Oh, T.S.; Cannon, R.M.; Rodel, J.; Glaeser, A.M.; Ritchie, R.O. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 17p. (CONF-880671—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009842/JAW.

From International conference on composite interfaces; Cleveland, OH, USA (13 Jun 1988).

Methods to toughen ceramicmetal interfaces that employ prescribed arrays of non-coplanar microcrack-like-voids and inclined interface steps are assessed. These features, developed in glasscopper samples made using photolithographic, metal deposition and diffusion bonding processes, promote crack-tip shielding principally from crack bridging by ligaments generated by plastic void growth within the copper. The ensuing plastic stretching, and sometimes tearing, of the Cu film ligaments yield the major energy dissipation. Crack deflection can also provide a smaller toughening contribution. Resistance-curve (R-curve) behavior obtains from the bridging, with fracture energies rising to an asymptote that varies from 9 to 160 Jm^2, compared with inherent toughness values of {approximately}2 Jm^2 for the specific glassCu interfaces used. The arrays retard subcritical crack-growth rates, which are higher in moist atmospheres, by orders of magnitude compared to rates for plain interfaces. The behavior is contrasted with that gained by using better interface chemistry to increase the inherent fracture toughness of glassCu bonds. 38 refs., 10 figs.

37381 **(PB—88-183918/XAB) Mitsubishi Cable Industries Review No. 74, October 1987.** (Mitsubishi Cable Industries Ltd., Tokyo (Japan)). 1987. 113p. NTIS, PC E05.

Text in Japanese with English abstracts. See also PB—88-183926 through PB—88-183942 and PB—87-225710; Portions of this document are not fully legible.

Partial contents include: Research and development of superconductors; Development of non-halogenated flame-retardant telecommunication cables and optical-fiber cables; New wiring system for fiber-optic networks in buildings; Optical trigger system for the Institute of Laser Engineering, Osaka University; Development of optical multiplex transmission system (MP-2000); Development of the optical data link DQ1M, DQ4M for polymer-clad silica core fibers; Development of LSI for multiplexing/demultiplexing (DN1811); Polymer optical circuits; Characteristics and application of rare-earth-doped optical fibers; Study on UV curable resins for optical fibers.

37382 **(SAND—87-2764C) Effects of X irradiation and high field electron injection on the properties of rapid thermal oxides.** Schubert, W.K.; Seager, C.H. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880549—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011620/JAW.

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The effects of x-ray exposure and high field electron injection on the electrical properties of capacitors incorporating rapid thermal oxides show a considerable dependence on the particular post-oxidation annealing (POA) conditions used during oxide processing. Most important seem to be the POA ambient and temperature. POA temperatures from 1150 to 800{degree}C have been investigated, with lower temperatures resulting in reduced midgap voltage shifts for a given x-ray dose or injected electron fluence. Low-temperature high field injection experiments on the present samples have failed to show a direct conversion from trapped holes to interface states formed after photoinjection of electrons as has been reported for conventionally grown thicker oxides. Rather, the injected electrons seem to simply neutralize the trapped holes, returning the capacitance-voltage curve to near its original position and shape. 30 refs., 4 figs.

37383 **(SAND—87-3017C) Phase comparator for range imaging laser radar.** Wessendorf, K.O.; Scott, M.W.; Grohman, M.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880579—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008109/JAW.

From 10. annual ideas in science and electronics exposition; Albuquerque, NM, USA (10 May 1988).

A range imaging laser radar using gallium arsenide (GaAs) laser technology has been developed. An image is constructed by scanning the beam in two dimensions over the scene. Our development system transmits an intensity modulated laser beam and determines range by measuring the phase difference of the local oscillator to that of the return signal. Since a 1GHz clock is used to measure this phase difference a theoretical maximum of 1 nsec., or six inches, of range change can be resolved. An amplifier is required to convert the received signal, of wide dynamic range, into a digital waveform for the counter circuit. To obtain the highest possible system resolution this amplifier must impart a minimum amount of phase shift over the dynamic range of the received signal. To maintain a high signal to noise ratio the amplifier must have a narrow bandwidth. Three approaches to the design of an appropriate signal amplifier were explored. A diode clamping amplifier, an automatic gain control circuit, and a cascaded differential amplifier were fabricated and tested. The differential amplifier circuit provided the best fit to the design goals and demonstrated a phase shift of {+-}3ns over a dynamic range of 70dB. This amplifier has been used in a radar to obtain range images of scale models of targets in the laboratory. 6 figs.

37384 **(SAND—87-3080C) Analytical design of a high bandwidth optoelectronic signal link for use in an EMP [electromagnetic pulse] plus radiation environment.** Anthes, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880579—5). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009470/JAW.

From 10. annual ideas in science and electronics exposition; Albuquerque, NM, USA (10 May 1988).

Electronic systems which must operate in an electromagnetic pulse (EMP) environment are often enclosed in a conducting box, or Faraday enclosure. The conducting walls must have apertures to allow communications with systems outside the enclosure. EMP leakage is minimized when the aperture diameter is small and has finite thickness. In addition, the penetration of a Faraday enclosure by a conductor may result in a significant portion of EMP induced noise inside the enclosure. Optical signals, because of their short wavelength, can efficiently traverse apertures that are highly attenuating to EMP signals. A communication link consisting of a GaAlAs laser diode source, optical fiber, and a photodiode detector is well suited to this application. Optical transport efficiency between an optical-fiber-coupled 10-stripe laser diode array and a radiation tolerant AlGaAs photodiode is optimized with a graded refractive index (GRIN) rod lens. The lens is positioned in the conducting wall of a Faraday enclosure. The radiation tolerant photodiode is contained inside the enclosure to control EMP induced degradation of the signal-to-noise ratio of the link. The AlGaAs photodiode double heterostructure design controls the ionizing-radiation-induced degradation of the link. An optical design analysis is performed to satisfy two criteria. First we select acceptable lens length-to-radius ratios for an aperture filled by a dielectric medium (the glass GRIN-rod lens). This criteria determines the upper limit

on potential EMP leakage through the lens and into the Faraday enclosure. Second, we utilize the lens image condition to achieve 98% optical transfer between a nanosecond response, optical-fiber-coupled laser diode and the radiation hardened photodiode. 15 refs., 6 figs.

37385 **(SAND—88-0094C) A weighting/threshold approach to sensor fusion.** Amai, W.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-8804128—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010349/JAW.

From 1. annual national symposium on sensor fusion; Orlando, FL, USA (5 Apr 1988).

A weighting/threshold-based sensor fusion algorithm to decrease the false alarm rate (FAR) while maintaining a high probability of detection (PD) is being tested in the Remote Security Station (RSS). The RSS is being developed to provide temporary intrusion-detection capability on short notice. It consists of a portable, multisensor pod connected by cable to a manned control console. The pod is set up outdoors in the location that security is needed; the console and operator are located in a command bunker up to a kilometer away. The RSS software filters out alarms from low-believability sensors and also filters out alarms in low-priority areas. Each sensor's believability is proportionally enclosed as a weighing, which is continually updated as a function of the environmental conditions affecting that sensor. Area priority is proportionally encoded as a threshold value for each pie-wedge area around the pod. When an event in an area triggers one or more sensors, their weightings are summed and then compared to the area threshold value. The operator is informed of the event only if the summed weighting exceeds the threshold. Extensive field testing has not yet been done, but some results show the current sensor fusion algorithm decreases the FAR at the expense of lowering the PD. To increase the PD while retaining a low FAR, the weighting/threshold algorithm will be modified to use temporal data and pattern recognition. 4 refs., 2 figs.

37386 **(SAND—88-0315C) Compact, repetitive, 6.5 kilojoule Marx generator.** Lancaster, K.T.; Clark, R.S.; Buttram, M.T. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 14p. (CONF-880699—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011784/JAW.

From 18. power modulator symposium; Hilton Head, SC, USA (20 Jun 1988).

Repetitive Marx generator technology developed has been actively pursued for many years at Sandia National Laboratories. Four repetitive Marx generators with voltages to 1 MV, energies to 20 kJ and repetition rates to 50 Hz have been built, tested, and used in on-line experiments. These devices have proven to be reliable pulsed power energy sources. The 440 kV, 6 kJ, 1 Hz Marx generator in this report was designed using this existing technology base. The repetitive Marx generator is an attractive power source for many applications for a variety of reasons. Circuit-wise a Marx is simple, being essentially a capacitor and inductor in series. This permits its use in a variety of configurations ranging from a pulse-forming line charger to an element of a pulse-forming network. At slow repetition rates (1 Hz to 10 Hz) Marx generators can be fabricated almost entirely from commercial components making them both inexpensive and quick to build. Generally they can be easily reconfigured as requirements change, making them a flexible laboratory tool. When designed conservatively, they are also useful for some commercial applications outside the laboratory. In this paper we illustrate the latter point by discussing the design and development of a compact field-transportable, repetitive Marx generator that was designed and built in three months. The authors also review the options considered before choosing the Marx design, and the use of commercially-available hardware in the Marx generator's construction.

37387 **(SAND—88-0458) Liquid Metal Thermal Electric Converter bench test module.** Lukens, L.L.; Andraka, C.E.; Moreno, J.B. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 300p. NTIS, PC A13/MF A01;1; GPO Dep. Order Number DE88009857/JAW.

This report describes the design, fabrication, and test of a Liquid Metal Thermal Electric Converter Bench Test Module. The work presented in this document was conducted as a part of Heat Engine Task of the US Department of Energy's (DOE) Solar Thermal Technology Program. The objective of this task is the development and evaluation of heat engine technologies applicable to distributed receiver systems, in particular, dish electric systems.

37388 **(SAND—88-0472C) P-well or N-well CMOS technology for advanced SEU-hard SRAMs.** Fu, J.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880730—4). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88006845/JAW.

From 25. annual conference on nuclear and space radiation effects; Portland, OR, USA (12 Jul 1988).

The decoupling resistances required for SEU hardening CMOS SRAMs of the 2μm p-well and n-well technologies are compared. An advanced device-plus-circuit simulator has been used to illuminate the underpinings of why one technology is intrinsically more SEU tolerant than the other. 3 refs., 5 figs.

37389 **(SAND—88-1139C) Sol-gel processing of metal-oxide-semiconductor structures.** Warren, W.L.; Lenahan, P.M.; Brinker, C.J. (Pennsylvania State Univ., University Park (USA). Dept. of Engineering Science and Mechanics; Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-8804114—1; CONF-8804114—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009853/JAW.

From Better ceramics through chemistry III; Reno, NV, USA (5 Apr 1988).

We have investigated the electronic properties of sol-gel derived films on silicon substrates. Our investigation involves SiO_2, aluminosilicate and borosilicate oxides on silicon. Some sol-gel oxides are excellent insulators; some sol-gel films on silicon also exhibit quite low oxidesilicon interface state densities. We have also subjected sol-gel films on silicon to 4 MRAD of radiation and have found that these structures appear to be radiation hard (very little oxide space charge or interface state generation). Our results strongly suggest that sol-gel processing could provide insulating films for a variety of microelectronic device applications. 21 refs., 6 figs., 2 tabs.

37390 **(SAND—88-1330C) Ellipsometric imaging of drying sol-gel films.** Hurd, A.J.; Brinker, C.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-880408—28). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011785/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

Although controlled dip-coating is an established way to apply high quality uniform coatings, the details of the coating and drying process have not been deeply studied. Depending on the physical and chemical state of the sol and the parameters of dipping (dipping angle and speed), a variety of thicknesses and porosities can be achieved. For optical coatings, the refractive index and optical thickness can thereby be controlled. The authors have developed a method to view the drying front of a dip-coated film using broad beam ellipsometry, or ellipsometric imaging. In dip-coated films we take full advantage of the fact that a steady state is quickly reached where the drying line velocity matches the withdrawal velocity; however, the technique might also be used in unsteady situations such as spin coating. Imaging ellipsometry makes it possible to measure the refractive index and thickness profiles of both wet and dry films point-by-point in an entire image at once. These profiles provide important clues as to the relative importance of gravity, evaporation and other phenomena.

37391 **(SAND—88-1579C) Electrical properties of metal-oxide-silicon structures with sol-gel oxides.** Warren, W.L.; Lenahan, P.M.; Brinker, C.J. (Pennsylvania State Univ., University Park (USA). Dept. of Engineering Science and Mechanics; Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880408—29). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011791/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

The authors have investigated the electronic properties of sol-gel derived films on silicon substrates. Our investigation involves SiO_2, aluminosilicate and borosilicate oxides on silicon. Some sol-gel oxides are excellent insulators; some sol-gel films on silicon also exhibit quite low oxide/silicon interface trap densities. We have also subjected sol-gel films on silicon to 4 Mrad(SiO_2) of radiation and have found that these structures appear to be radiation hard (very little radiation induced oxide space charge or interface trap generation). Our results strongly suggest that sol-gel processing could provide insulating films for a variety of microelectronic device applications.

37392 **(SAND—88-8215) An OKQPSK modem incorporating numerically controlled carrier synthesis.** Oetken, R.E. (Sandia National Labs., Livermore, CA (USA)). 4 Apr 1988. Contract AC04-76DR00789. 50p. NTIS, PC A03;3. Order Number DE88009536/JAW.

The feasibility of incorporating numerically controlled oscillators (NCO) in communication related applications is evaluated. NCO generation of sinusoids may prove useful in systems requiring precise frequency control, tuning linearity, and orthogonality versus frequency. An OKQPSK modem operating at a data rate of 200 kb/s was fabricated. The modem operates in a back to back hardwired channel and thus does not incorporate carrier or symbol timing recovery. Spectra of the NCO generated sinusoids are presented along with waveforms from the modulation and demodulation process. Generation of sinusoids in the digital domain is a viable alternative to analog oscillators. Implementation of an NCO should be considered when frequency allocation, tuning bandwidth, or frequency hopped transmission requires precise frequency synthesis. 24 figs.

37393 **(UCRL—97765) A GaAs solid state device model for high power applications.** Orvis, W.J.; Khanaka, G.H.; Yee, J.H. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 11p. (CONF-8805132—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011320/JAW.

From 4. national high power microwave conference; Monterey, CA, USA (9 May 1988).

Due to their speed and radiation tolerance, gallium arsenide solid state devices are becoming more and more prevalent in consumer and defense electronics. Because of this increase in use, we have modeled gallium arsenide device operation in the high power, short pulse regime. This modeling includes avalanche generation, heat generation and flow, and inter-valley transfer of electrons. 10 refs., 7 figs., 1 tab.

37394 **(UCRL—98572) A channelless, multilayer router.** Lunow, R.E. (Lawrence Livermore National Lab., CA (USA)). 15 Mar 1988. Contract W-7405-ENG-48. 6p. (CONF-880649—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011333/JAW.

From 25. ACM/IEEE design automation conference; Anaheim, CA, USA (12 Jun 1988).

We have implemented a channel-less, gridless, multilayer router as part of the Magic IC layout system. The router is designed to handle new routing problems associated with emerging technologies such as Wafer Scale Integration and multilayered metal processes. Three features distinguish this router: rectilinear Steiner trees with floating segments, a routing scheduler, and a corner-stitched database. 7 refs., 2 figs., 4 tabs.

37395 **(UCRL—98609) An interactive maze router with hints.** Arnold, M.H.; Scott, W.S. (Lawrence Livermore National Lab., CA (USA)). 15 Mar 1988. Contract W-7405-ENG-48. 15p. (CONF-880649—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011332/JAW.

From 25. ACM/IEEE design automation conference; Anaheim, CA, USA (12 Jun 1988).

This paper presents the Irouter, an interactive maze router for the Magic IC layout editor that takes hints. The Irouter is a flexible tool intended to be useful wherever tight or unusual constraints do not permit automatic routing. It has already been used in the layout of an 80,000 transistor CNOS chip developed by our group at LLNL, and is currently being used to route the control signals of a 100,000 transistor, high performance, EPU chip being developed by the Berkeley SPUR project. Several novel ideas for maze routing have been developed in the Irouter. Hint layers permit the user to map out the general path of a route and pull the route in desired directions, while leaving detail, such as obeying the design rules, to the router. The gross structure of the layout is preprocessed to facilitate accurate estimates of cost to completion during routing and hence effective pruning of misdirected partial routes. A windowed search strategy slowly shifts the focus from the start point towards the goal. This permits the consideration of alternatives at all stages of routing without blowing up into an exhaustive search. 11 refs., 6 figs.

37396 **Schottky barrier instabilities due to contamination.** Newman, N.; Liliental-Weber, Z.; Weber, E.R.; Washburn, J.; Spicer, W.E. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94305, Material and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* **53**: No. 2, 145-147(11 Jul 1988).

We reported here a systematic study of the annealing-induced changes in the barrier height of Schottky barrier diodes fabricated on atomically clean and contaminated surfaces. Al, Ag, Au, and Cr/GaAs(110) diodes were fabricated by in situ deposition on clean n-type GaAs(110) surfaces prepared by cleavage in ultrahigh vacuum and on contaminated surfaces prepared by cleavage and exposure to the atmosphere for ~1—2 h. This study demonstrates that the as-deposited barrier height and the annealing-induced changes in the barrier height of diodes formed with an interfacial layer of contamination are distinctly different from the characteristics of diodes formed on clean semiconductor surfaces. The presence of an interfacial layer of contamination is found to significantly degrade the stability of the diode's barrier height to annealing.

37397 **Schottky barrier formation on $(NH_4)_2S$-treated n- and p-type (100)GaAs.** Carpenter, M.S.; Melloch, M.R.; Dungan, T.E. (Purdue University, School of Electrical Engineering, West Lafayette, Indiana 47907). *Applied Physics Letters;* **53**: No. 1, 66-68(4 Jul 1988).

Because of a large surface state density, which effectively pins the Fermi level at the surface, metals with vastly different work functions and chemistry produce very similar Schottky barriers when deposited on GaAs. We have investigated the effects of an $(NH_4)_2S$ surface treatment on the formation of Schottky barriers on n- and p-type GaAs. Samples which have undergone the $(NH_4)_2S$ treatment show a reduced pinning of the Fermi level at the surface and hence Schottky barriers which are more sensitive to the metal work function.

37398 **Stepped linear piston displacement fundamental leak calibration system.** Thornberg, S.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 4, 2522-2527(Jul 1988).

A fundamental leak calibration apparatus has been developed that measures gas leak rates. The stepped linear piston displacement (SLIPD) system decreases the calibration time for leaks in the 10^{-11}—10^{-6} mol/s (2×10^{-7}—2×10^{-2} atm cm^3/s at 0 °C) range without increasing the uncertainty when compared to other related techniques. Calibration times have been reduced by up to a factor of 10 (depending on the leak rate) over the current P ΔV system used by the Sandia Primary Standards Laboratory for more than

four years. The SLIPD system is computer controlled and requires minimal operator input. Furthermore, the total systematic uncertainty of < +- 1.1% (from 10^{-10} to 10^{-6} mol/s) is roughly the same as that for a P ΔV system and intercomparisons between the two systems for the same leaks agree to better than +- 1.0%.

37399 **Data acquisition system for an electron beam welder.** Milewski, J.O.; Dixon, R.D. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 4, 2586-2588(Jul 1988).

A data acquisition system for an electron-beam welder has been designed and fabricated. The data acquisition system has been used for precise doc umentation of weld variables, storage of the data and subsequent statistic al analysis of the data. Observation of the data during weld studies has shown that some maintenance was needed by the welder. The accuracy with w hich we can monitor the weld parameters is significantly better than that available with existing metering. (AIP)

37400 **(ORNL/tr—88/9) Current status and trends in compressor development: 3, Supporting components for compressors: 3.1, Inverter.** Ide, Yuichi; Kanazawa, Hidetoshi. Translated from Reito [Refrigeration] *Reito ;* 62: No. 721, 47-53(Nov 1987). Contract AC05-84OR21400. 23p. Q/MF A01;1.

It has been 7 years since the inverter-controlled air conditioner was introduced in 1980 as a commercial air conditioner. In the following years, it was applied to the residential heat pump air conditioner. During the past seven years the technology and product reliability of the inverter have improved significantly. Many characteristics of the inverter such as heating and cooling capability, comfort, and energy efficiency have also improved since the first unit was introduced. In the domestic market, moreover, approximately {1/3} of all air conditioners (1 million units for the 1987 cooling year) are expected to be of the inverter type, and the inverter has become an integral part of air conditioners. The major components of the inverter are semiconductors such as microprocessors and power transistors. The reason the inverter technology for air conditioner has rapidly improved is that the technical advancement of these components coincided with the timing of the development of the inverter air/conditioner. This paper discusses current trends and future development of inverter technology with emphasis on the inverter used in home air conditioners.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 35916, 35933, 37578, 37822

37401 **(PNL-SA—15872) Site characterization: technical approaches to RCRA compliance.** Smith, R.M.; Schalla, R. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 12p. (CONF-8805144—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011895/JAW.

From Hazardous waste outlook for the 90's; Spokane, WA, USA (23 May 1988).

The basic premise of this report is that RCRA compliance for site characterization and ground-water monitoring is subject to technical interpretation resulting in a negotiated compliance between the responsible party and the regulatory agency. The degree to which the responsible party can exercise technical license in designing a ground-water monitoring system varies between components of the system. However, the responsible party must convince the regulatory agency that the data collected truly represent the ground-water system and that the approach taken is technically sound. While much progress has been made toward developing tools and strategies for adequately characterizing disposal sites, additional developments are needed in both monitoring hardware and interpretive techniques.

37402 **(STEV-FBT—88-12) Measurements of the environment at the pilot plant for condensor flue gas cleaning at Hoegdalen plant.** Ericsson, S.O.; Lindman, E.K. (Statens Energiverk, Stockholm (Sweden)). 20 Aug 1987. 186p. (In Swedish). NTIS (US Sales Only), PC A09. Order Number DE88753338/JAW.

A comprehensive study was carried out during 1986. The flue gas cleaning facility consisted of an economizer, a cleaning reactor and a water treatment system. Flow rates, degrees of separation and emissions to air and water of acidiferous substances, mercury, dust and heavy metals were measured under 12 different sets of operating conditions. Dioxines and other organic compounds were measured under two sets of operating conditions. A total of 4000 analyses were performed. In conjunction with the environmental study, material testing of the scrubber was also carried out. Corrosion was 3-20 times greater in the flue gas inlet than in the water zone. (G.B.).

4210 Combustion Systems

REFER ALSO TO CITATION(S) 35608, 35609, 35610, 35616, 35631, 35933, 36150, 36151, 36888

37403 **(KTM/E-D—120) Absorption heat pumps.** Huhtinen, M.; Heikkilae, M.; Andersson, R. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Mar 1987. 89p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752820/JAW.

The aim of the study was to analyse the technical and economic feasibility of absorption heat pumps in Finland. The work was done as a case study: the technical and economic analyses have been carried out for six different cases, where in each the suitable size and type of the heat pump plant and the auxiliary components and connections were specified. The study also detailed the costs concerning the procurement, installation and test runs of the machinery, as well as the savings in energy costs incurred by the introduction of the plant. Conclusions were drawn of the economic viability of the applications studied. The following cases were analysed: Heat recovery from flue gases and production of district heat in plants using peat, natural gas and municipal wastes as a fuel. Heat recovery in the pulp and paper industry for the upgrading of pressure of secondary steam and for the heating of white liquor and combustion and drying air. Heat recovery in a peat-fulled heat and power plant from flue gases that have been used for the drying of peat. According to the study, the absorption heat pump suits best to the production of district heat, when the heat source is the condensing heat of flue gas moisture and the primary energy is steam produced by the boiler. Included in the flue gas condensing is the purification of flue gases. Accordingly, benefit is gained on two levels in this application. In heat and power plants the use of absorption heat pumps is less economical, due to the fact that the steam used by the pump reduces the production of electricity, which is rated clearly higher than heat.

37404 **(KTM/E-D—127) Possibilities and costs of reducing the nitric oxide emissions from the energy production.** Jaanu, K. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 140p. (In Finnish). NTIS (US Sales Only), PC A07. Order Number DE88752821/JAW.

The nitric oxide emissions in Finland are annually about 220,000 tonnes as expressed in terms of NO_2, of which the share of the traffic is more than a half. Peat and heavy fuel oil in energy generation cause emissions equally much per energy unit, whereas the specific emissions caused by coal are bigger, even twice as much. Regionally nitric oxide emissions are biggest in southern Finland because of heavy traffic and large energy supply. For the environment the emissions caused by the traffic are most dangerous as emissions "disappear" slowly from the "canyons" of the streets. It is cheapest to reduce nitric oxide emissions in power plant boilers if only combustin technical solutions are used. In that case it is possible to achieve a reduction of 40-50% and even higher in fluidized bed combustion. By installing the catalytic nitric oxide reduction equipment to the end part of the plant it is possible to reduce emissions as much as 15-20% from the starting level. However, the catalytic equipment means today an additional cost of FIM 3-

4MWh in fuel at the solid fuel fired plants. The biggest cost factor is the ageing of the catalyzer. However, the catalytic removal of NO/sub x/ emissions from big power plants is much cheaper than the catalytic removal of NO/sub x/ in traffic. At small heavy fuel oil fired plants the cheapest way of reducing nitric oxide emissions is to use low-nitric fuel oil. At the same time, sulphur, sulphur oxide, solid particles and heavy metal emissions also reduce. Combustion technique increases solid particle emissions in heavy fuel combustion. The catalytic cleanin method is not suitable for oil-fired boilers in discontinuous use. Nitric oxide emissions of wood and wood waste are low, the same applies to light oil and natural gas except gas turbines. For gas turbines the combustion technique is bringing new solutions.

37405 **(KTM/E-D—132) Condensing boilers using natural gas as a fuel. Preliminary study.** Lihavainen, L.; Kauppinen, H. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 36p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752822/JAW.

A condensing boiler utilises the latent heat contained in the flue gases by condensation of the water vapour. Using the latent heat of condensation means a remarkable improvement in an annual efficiency. An actual condensing boiler can reach an annual effeciency of 96 to 102% (calculated with the net heat value of natural gas). In comparison with a conventional one, a high efficiency condensing boiler can offer significant gas savings (even 25%). The operating principle of a condensing boiler is simple: the main difference compared to a conventional boiler is the second heat exhanger, where the condensation occurs. The first heat exhanger operates dry as in a conventional boiler. To achieve the maximum benefit from a condensing boiler, a low return boiler water temperature and a high water dew point of the flue gases are the most important requirements. The condensate is acidic. Therefore materials for condensing boilers as well as for flue ducts and sewer pipes should be corrosion resistant. Natural gas is an ideal fuel for condensing boilers because of a high water dew point of the flue gases, a high content of water vapour in the flue gases, a very low content of sulphur and a possibility to operate at the low levels of excess air.

37406 **(KTM/E-D—140) Nitrogen oxide emissions from the various types of boilers in Finland.** Hupa, M.; Backman, R.; Bostroem, S. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Aug 1987. 127p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752827/JAW.

This report discusses nitrogen oxide emissions from the various types of boilers in Finland. The boilers have been classified into 61 classes according to their size, combustion technique and main fuel. A specific emission coefficient (mg NO_2MJ) for each class has been determined, based on literature survey and actual measurements. The total NO/sub x/-emission has been calculated for each class using the emission coefficient and energy statistics. The effect of various techniques for emission reduction has also been investigated. The development of NO/sub x/-emissions has been estimated for both the case where no preventing actions have been taken and for four defined cases where alternative reduction measures are assumed. Further a calculation is made of the total investment required for two of the cases. The total NO/sub x/-emission from energy production was 96 000 t NO_2 in 1986. Two thirds of this amount originated from boilers larger than 5 MW and the rest from smaller boilers and industrial processes. The two most important boiler classes from the NO/sub x/-emissions point of view were coal fired boilers with an emission of approx. 24 000 t NO_2 and boilers fired with a mixture of fuels, approx. 15 000 NO_2. By 2005 the total NO/sub x/-emission from energy production would increase 60% to approx. 160 000 tons if it is left uncontrolled. The emission level would be 140 000 tons if primary reduction techniques are applied and 110 000 t NO_2 if also catalytic NO/sub x/ reduction devices are installed in boilers larger than 300 MW.

37407 **(ORNL/M—462) Ceramic Technology for Advanced Heat Engines Program data base: A summary report.** Booker, M.K. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 94p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88008954/JAW.

A large amount and wide variety of data on the behavior of advanced ceramic materials is currently being generated within the Ceramic Technology for Advanced Heat Engines Program. This paper summarizes efforts to date to develop a computer data base system for the management of those data. The system is based on the use of desktop microcomputers, which provides a maximum of efficiency, economy, and convenience in the operation of the system.

37408 **(STEV-FBT—88-4) Investigation of straw combustion systems. The combustion laboratory in Borgeby.** Paahlstorp, S.; Nilsson, S. (Statens Energiverk, Stockholm (Sweden); Swedish Univ. of Agricultural Sciences, Lund. Dept. of Farm Buildings). 1987. 85p. (In Swedish). (SLU-LBT-S—148). NTIS (US Sales Only), PC A05. Order Number DE88752956/JAW.

The Department of Farm Buildings at the Swedish University of Agricultural Sciences has built a combustion laboratory to improve the straw combustion systems together with the manufacturers. By practical tests, faults and bad constructions will be found. In the next phase the constructions will be improved together with the manufacturer to receive better reliability and combustion comfort. In the laboratory the variation of the fuel feeding is measured and how the furnace is interferred by different settings. The combustion air flow is measured as well as the output power. In the flue gases temperature, carbon dioxide, carbon monoxide, nitrogen monoxide and dust emissions are measured. (authors).

37409 **(STEV-FBT—88-10) Bioturbo report.** Tiberg, L. (Statens Energiverk, Stockholm (Sweden)). 8 May 1987. 24p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88753337/JAW.

The Bioturbo system is a pressurized boiler for wet solid fuels with means for condensing the water vapour in the flue gases. The compression of the flue gases is made by standard automotive turbochargers which are modified to suit the abnormal air/gas volume relationship of the system. The combustion takes place in a pressurized fluidized bed. The condensing cooling takes place at an intermediate pressure between the primary and the secondary turbine expansion. A number of basic investigations have been made. Different systems have been analysed. Efficiencies of available turbochargers have been investigated. A general computer program for the system was developed. Erosion of turbines and cyklones were investigated. It was found possible to avoid erosion with two cyklones in series before the turbine. Heat exchangers with condensing systems were calculated and tested. The corrosion situation of condensing systems was analysed. It was found possible to avoid corrosion by keeping surface temperatures below the water dew point. Gas cleaning efficiency was found to be much higher at expansion cooling than by contact cooling.

37410 **(STEV-FBT—88-13) Small-scale firing with firewood.** Amany, A.; Sylwan, C. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Technology). 1988. 38p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753339/JAW.

This investigation concerns circumstances which influence the quantities of unwanted emissions when firing in a smaller woodstove. The influence of the following factors was investigated: Configuration of the woodcharge, the use of different types of firebasket,the use of thermostat and catalyst and finally the method of ignition. The measured were burnrate, CO-emission, O2-content and temperature in the flue gas. The results show that the most favourable conditions were achieved with the logs standing tight on a firebasket of such configuration that falling logs would place themselves near the remaining standing logs. Furthermore high temperature proved favourable and so did the use of catalyst. The catalyst also need high temperature to function well. In order to achieve these high temperatures in an earlier stage of the firing we used thermal insulation of the fireplace. (authors).

37411 **(SVF—261) Steam jet heat pump for heat recovery from flue gases.** Lundqvist, P. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Apr 1987. 50p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752985/JAW.

A major part of the heat in the flue gases, especially when dealing with moisty combustibles, is regained when the moist is condensing, a temperature of 40-50 degrees C is required for the cooling agent. This implies that a heat pump is needed to lift heat energy to a more useful temperature level. This level, in this study, is assumed to be the temperature of returning water in a district heating system (70-80 degrees C) This study shows that a steam jet ejector system is a possible solution for heat recovery in flue gases. There are two major limiting factors: the maximum motive steam pressure that can be maintained in the boiler and the temperature in the district heating system. The type of fuel has a very strong influence on the possible profit with this kind of heat recovery system. A fuel with high water content, as biomass, gives flue gases containing a large amount of heat energy. In order to recover this a high efficiency ejector is required. An ejector is given high efficiency by using high pressure steam and by decreasing the temperature span between the evaporator and the condenser. A steam jet heat pump is an uncomplicated construction without moving parts. This gives it qualifications for reliability in running and a minimum of need for maintenance. Since the refrigerant and the cooling agent is water the environmental effects are insignificant. As disadvantegeous we find high intensity of noise and that it is rather bulky. This report shows that a biomass combustion plant on 1 MW needs a heat recovery system on approximately 200 kW cooling power. This is the size we suggest for a prototype steam jet heat pump.

37412 **(SVF—275) Joint combustion tests with coal powder and wood powder in an existing oil fired boiler plant.** Thaning, G. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Aug 1987. 35p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753347/JAW.

The trials were performed in an originally oil fired hot water boiler, which was converted into a boiler fuelled by coal powder. The series of tests involved 12 separate trials where each trial operated for two hours. The firing tests were carried out with the mixture proportions of 100/0 per cent, 67/33 per cent, 50/50 per cent, 33/67 per cent and 0/100 per cent, coal/wood powder expressed as heat equivalent percentage. Each test was carried through with an oil support but also without oil support in those cases this could be done. The interval of mixture for acceptable firing includes all the range from 100 per cent coal powder to 100 per cent wood powder. However, oil support was needed in the mixture interval between 33/67 per cent and 0/100 per cent coal/wood powder. A pronounced decrease of the Nosub(x) emission was obtained when the share of wood powder was increased in the mixture. It was reduced by 40 per cent from 0.21 g/MJ (100 per cent coal) to 0.13 g/MJ in a 50/50 per cent mixture and further to 0.10 g/MJ for a pure wood firing. The sulphur content of the flue gas decreased linearly with increasing wood powder addition, which could be expected as a result of the dilution effect. The sulphur content of wood powder is an order of magnitude less than that of coal powder. The sulphur emission was reduced from 0.24 g S/MJ (100 per cent coal) to 0.03 g S/MJ (100 per cent wood). In comparison with oil firing the rated output of the boiler was reduced from 9 MW to 8.4 MW (7 per cent) when a mixture of 50/50 per cent coal/wood powder was used in a full load test. The lowest load that was obtained with a steady flame for the same mixture was 5.2 MW. The amount of unburnt material in the ash varied from 18 per cent for a pure wood powder firing to 44 per cent for a 67/33 per cent coal/wood powder mixture. No increased fouling or slagging in the furnace was observed after completion of all the tests as compared to commercial coal powder firing.

37413 **(SVF—279) Secondary supply of wood and peat powder when firing coal powders. Investigation of the effect on NOsub(x) emission.** Rudling, L. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). Oct 1987. 105p. (In Swedish). (STUDSVIK-EP—87-4). NTIS (US Sales Only), PC A06. Order Number DE88752990/JAW.

The NOsub(x) reduction potential of pulverized wood and peat as reburning fuels during combustion of pulverized coal has been investigated. The experiments were carried out in a laboratory scale experimental furnace (diameter 0.3m, length 4m). The primary fuel flow of coal was 10 kg/h. As reburning fuel pulverized wood and peat was compared to propane. The results showed that pulverized wood gave almost the same NOsub(x) reduction as propane. For propane the emission was 85-90 mg NOsub(x)/MJ and for wood the emission was 90-95 mg NOsub(x)/MJ. Pulverized peat was somewhat less efficient than wood as reburning fuel with a NOsub(x)-emission of 140 mg/MJ. The difference is believed to be due to the higher nitrogen content of the peat.

37414 **Sealing apparatus utilizing a conformable member.** Neef, W.S.; Lambert, D.R. (to Dept. of Energy, Washington, DC). US Patent 4,735,421. 5 Apr 1988. Filed date 10 Aug 1982. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a sealing apparatus comprising: (a) housing means having a closed end and an open end and defining a single chamber therein; (b) at least one deformable means forming a substantially flat surface, and attached to the open end of the housing means in a manner to close the chamber; (c) apertured means positioned adjacent to the deformable means and secured to the housing means adjacent to but spaced from the open end for preventing substantial movement of the deformable means into the chamber; and (d) urging means including fluid pressure supply means operatively connected to the chamber for pressurizing the chamber and for deforming the deformable means outwardly from the chamber into contact with an associated surface to form a seal therebetween.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 36455, 36458

4230 Marine Engineering

37415 (CONF-8609418—, pp 573-606) **Offshore foundations of the platform Schwedeneck.** Quast, P.; Salewski, J.; Wagner, P. (Grundbauingenieure Steinfeld und Partner, Hamburg (Germany, F.R.); Bilfinger und Berger A.G., Wiesbaden (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88770212/JAW.

From Meeting and technical exhibition on construction foundations; Nuernberg, F.R. Germany (22 Sep 1986).

In 1983 the first German production platforms were installed in the oil field 'Schwedeneck-See', Baltic Sea. At the proposed locations a comprehensive soil investigation program was conducted. The liquefaction potential and the reduction of shear strength due to cyclic loading were of special importance. The essential construction stages and the foundation examinations are described.

37416 (DTH-ISVA-PR—65, pp 21-30) **Effect of Reynolds number on the in-line vibrations of pipelines.** Jensen, B.L. (Inst. Hydrodyn. and Hydraulic Engrg., Tech. Univ. (DK)). 1987. NTIS (US Sales Only), PC A04/MF A01.

In [Vibrations of Pipelines]. Progress report.

The equation of motion for the in-line movements of free spanning pipelines is solved for different values of the relevant parameters such as Reynolds number, Keulegan-Carpenter number, gap ratio etc. The results are presented in the form of series of diagrams, covering $10^4 < Re < 10^6$ and $10 < KC < 100$.

37417 **(NEI-DK—76) Suction anchors. Anchoring system for floating offshore structures.** Larsen, P. (Geoteknisk Inst., Lyngby (Denmark)). Jan 1988. 82p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752918/JAW.

This report deals with the use of suction anchors as an anchoring system for floating offshore constructions. Previous litterature and experience concerning the physical aspects of installation and load capacity during employment are evaluated, and a model-

test program is developed on this basis. The water flow conditions in the suction anchor and its influence on the down suction during installation are theoretically examined (finite element method); these results are compared with observations from down suction of model anchors as well as with available published information. Tests are at first carried out by subjecting the anchors to a static pull. Thereafter the tests are repeated under identical experimental conditions using a harmonically oscillating traction on the anchor. The purpose of this approach is to elucidate possible variation in horizontal ultimate bearing capacities between the two types of loads. Test results are given in the report in the form of load-displacement diagrams that illustrate relationships between applied horizontal force and horizontal displacements. It is evident from these diagrams that the estimated horizontal ultimate bearing capacity for suction anchors in sand is equally large for the two types of applied forces. Supplementary model tests have been carried out using an 0.1 m anchor in clay and kaolin. Load-displacement curves from these investigations show a clear difference in horizontal ultimate bearing capacity between the two types of stress. The ultimate bearing capacity for experiments conducted using oscillating load on suction anchors in clay and kaolin is estimated to be only half the ultimate bearing capacity for static load. 31 refs. (SM).

37418 **(NEI-NO—38) Telecommunications in connection with the offshore petroleum activity.** (Norsk Hydrologisk Komite, Oslo (Norway)). 1984. 233p. (In Norwegian). (CONF-8405446—). NTIS (US Sales Only), PC A11. Order Number DE88752841/JAW.

From Telecommunications in connection with the offshore petroleum activity; Kristiansand, Norway (28 May 1984).

The conference proceedings contain 19 papers. The topics covered are: Telecommunications in the North Sea; Who has the telecommunications engineering capacity? Concession obligation, obligatory equipment and technical requirements - the regulations of the Norwegian Telecommunications Administration; Loudspeaker and alarm installations on offshore platforms; Telephone systems and networks for offshore platforms; Satelitte communications to platforms - present day and in the future; The use of offshore microwave communications; Power supply plants for communications systems; Radio/TV entertainment installations; Telecommunication cables for offshore applications; Electric installations in areas with a danger of explosion; Fiber optics applications and possibilities offshore; Telecommunications net for STATPIPE; Data communications; New communications systems offshore. Separate abstracts were prepared for none of the papers of the proceedings.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 35606, 35613, 35626, 37404, 37578

37419 **(PB—88-186705/XAB) Low-flow-rate laboratory feeders for agglomerative particles.** Gullett, B.K.; Gillis, G.R. (Acurex Corp., Research Triangle Park, NC (USA)). 1987. 7p. NTIS, PC A02/MF A01.

Pub. in Powder Technology 52, 257-260(1987).

The paper describes two particle feeders (fluidizing and entrainment): one was developed by modifying a design used for coal-dust suspensions, and the other was developed later in response to shortcomings of the initial system. The two feeders were tested and compared for their performance at feeding $Ca(OH)_2$ sorbents. The development and operation of a particle feeder for laboratory-scale, gas/solid-flow reactors is crucial in many research efforts. On this small scale, it is particularly difficult to feed particles at high mass rates without quantities of carrier gas that disrupt the operation of the reactor. These problems have been encountered in research programs involving the injection of limestone-based sorbents into utility boilers for the removal of SO_2. The injection systems for these reactors must be designed to minimize the effects of the sorbent carrier gas upon the simulated utility-boiler environment.

37420 **(PB—88-191176/XAB) Industrial Combustion Emissions (ICE) model, Version 6.0. Software description. Final report, March 1985-February 1986.** Hogan, T. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Feb 1988. 100p. NTIS, PC A05/MF A01.

For system on magnetic tape, see PB—88-172226.

This report describes the software of the Industrial Combustion Emissions (ICE) model, developed to support the EPA's analysis of acid-deposition control alternatives. The model projects industrial fossil-fuel-fired boiler fuels, air emissions, and costs by state for 1985, 1990, 1995, 2000, 2010, 2020, and 2030. The current base year in the ICE model (Version 3) is 1980. Fuels include natural gas, distillate and residual fuel oil, and coal. Air emissions include sulfur oxides, sulfates, and nitrogen oxides. The report describes the structure of the ICE model (Version 6.0) computer programs, its input and output data files, major internal variables and constants, and the use of comment statements in the model's source code for one of the subroutines. It does not provide the necessary Job Control Language to run the model.

37421 **Hot gas cross flow filtering module.** Lippert, T.E.; Ciliberti, D.F. (to Dept. of Energy, Washington, DC). US Patent 4,737,176. 12 Apr 1988. Filed date 12 Nov 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A filter module for filtering particulates from a mixture of particulates in a high temperature gas is described comprising: a duct having an interior space; filter elements; support mounts, means for securing the filter element to the upper surface of the support mount over the opening, and the filter elements each being supported on the inwardly directed rim of a respective support mount by engagement means which causes contact of the lower wall of a filter element with the rim.

37422 **Random control at n/sup 2/ points using n shakers.** Paez, T.L.; Smallwood, D.; Buksa, E. (Sandia National Labs., Albuquerque, NM (US)). pp 271-275 of Proceedings of the 33rd annual technical meeting of the institute of environmental sciences on environmental technology: Knowing the way. Mt. Prospect, IL; Institute of Environmental Sciences (1987). (CONF-870566—).

From Institute of Environmental Sciences annual meeting; San Jose, CA, USA (4 May 1987).

Until recently, random vibration tests performed in the laboratory were typically run using single-point control with the excitation generated using one vibration exciter. Recently, a method was developed for the coherent control of multiple vibration exciters. The method was implement at Sandia National Laboratories and has been used successfully. This new method for testing permits the simultaneous control of the autospectral density of motion at n points on a structure, and the cross-spectral density of motion between every pair of control points. It is shown in this paper that use of the present control technique also permits random vibration control of the autospectral density at n/sup 2/ points during an n-shaker test.

4250 Power Cycles

37423 **(CONF-880702—4) C-CAMP, A closed cycle alkali metal power system.** Wichner, R.P.; Hoffman, H.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. (CONF-880702—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009715/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

A concept is presented for a Closed-Cycle Alkali Metal (C-CAMP) power systems which utilizes the heat of reaction of an alkali metal and halogen compound to vaporize an alkali metal turbine fluid for a Rankine cycle. Unique features of the concept are (1) direct contact (heat exchange) between the reaction products and turbine fluid, and (2) a flow-through chemical reactor/boiler. The principal feasibility issues of the concept relate to the degree of cross-mixing of product and turbine fluid streams within the reactor-boiler. If proven feasible, the concept may be adapted to a range of fuel and turbine fluids and ultimately lead to thermal efficiencies in excess of 35%.

37424 **(DOE/NASA/50112—74) Test results of a 40-kW Stirling engine and comparison with the NASA Lewis computer code predictions.** Allen, D.J.; Cairelli, J.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Sverdrup Technology, Inc., Cleveland, OH (USA)). 1985. Contract AI01-85CE50112. 14p. (NASA-TM—87050; CONF-850808—33). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008076/JAW.

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

A United Stirling 4-95 Stirling engine was tested without auxiliaries at the NASA Lewis Research Center. Three different regenerator configurations were tested with hydrogen. The test objectives were: (1) to obtain steady-state and dynamic engine data, including indicated power, for validation of an existing NASA Lewis computer model for that engine; and (2) to evaluate structurally the use of silicon carbide regenerators. This paper presents comparisons of the measured brake performance, indicated mean effective pressure (IMEP), and cyclic pressure variations, with those predicted by the code. The result of these NASA Lewis P-40 Stirling engine tests can be summarized: 1. The computer code developed at NASA Lewis did predict, with reasonable accuracy, the performance of the engine throughout the range of operating points tested. In particular, the predicted brake power and brake efficiency agreed quite well with the standard and part-power regenerator data. 2. IMEP trends for the code followed the actual measured curves as observed from the MEIS system. The measured IMEP data was consistently lower than the predicted values. 3. Measured dynamic pressures are similar amplitude and an apparent phase shift.

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 37767, 38631

37425 **(FNAL/C—88/31) QA [Quality Assurance] role in advanced energy activities: Towards an {open←quotes}orthodox{close←quotes} Quality Program: Canonizing the traditions at Fermilab.** Bodnarczuk, M.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). Feb 1988. Contract AC02-76CH03000. 11p. (CONF-870950—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008054/JAW.

From 14. annual National Energy Division of the American Society of Quality Control conference; Las Vegas, NV, USA (14 Sep 1987).

After a brief description of the goal of Fermi National Accelerator Laboratory (Fermilab) this paper poses and answers three questions related to Quality Assurance (QA) at the Laboratory. First, what is the difference between 'orthodox' and 'unorthodox' QA and is there a place for 'orthodox' QA at a laboratory like Fermilab? Second, are the deeper philosophical and cultural frameworks of high-energy physics acommodating or antagonistic to an 'orthodox' QA Program? Finally, faced with the task of developing an institutional QA program for Fermilab where does one begin? The paper is based on experience with the on-going development and implementation of an institutional QA Program at Fermilab. 10 refs.

37426 **(Juel-Spez—416) Introduction to the accelerator techniques for synchrotrons and storage rings.** Martin, S.; Richert, A.; Sobotta, K. (comps.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Sep 1987. 121p. (In German). (CONF-8610412—). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

From COSY seminar; Simonskall, F.R. Germany (31 Oct 1986).

This report includes the manuscripts of the papers presented at the training seminar on COSY techniques. Lectures on the fundamentals and discussion sessions of specialists took place under seclusion, covering the main topics magnet technology, power supply, instrumentation, and rf and diagnosis at COSY. With the experts from CERN, SIN, GSI, MPI, and BESSY existing solutions for COSY were discussed as well as criticized, and technical improvements were elaborated. (orig./HSI).

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 37386, 37463, 37878, 37879, 37881, 37882, 38322, 38640, 38915

37427 **(BNL—41333) Status of the Alternating Gradient Synchrotron (AGS) upgrade project.** Sluyters, T. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-880695—5). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011621/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The upgrade of BNL's Alternating Gradient Synchrotron progresses parallel with the construction of the 1.5 GeV Booster with a view to completion of its major components in 1991. The initial goals of the upgrade program are: to prepare the AGS ring for acceleration of at least 5 {times} 10^{13} protons per pulse, to accelerate heavy ions up to gold, to accelerate polarized protons in the 10^{12}-10^{13} intensity range, and to improve the reliability and flexibility of the present machine operation. Figure 1 shows the AGS complex as it will operate in 1991. There are several major systems in the AGS complex which have to be upgraded in order to accelerate the higher intensity beams and heavier ions. These systems are: the RFQ preinjector, the rf cavities, the vacuum, the transverse dampers, the correction magnets, extraction equipment, and the Siemens main magnet power supply. Additional major projects, which will keep the ring activation within {open←quotes}acceptable{close←quotes} limits despite a four-fold increase in beam intensity, are a fast beam chopper, a gamma-transition jump system, and a high frequency dilution cavity. These last projects have received high priority because they benefit as well the present operation of the AGS.

37428 **(LA—11265-MS) Design of high-power radio-frequency drive loops for operation into 425-MHz linear accelerators.** Liska, D.; Dauelsberg, L. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010305/JAW.

Recent designs for ultra high-frequency (UHF) band accelerators have prompted the need for high-powered drive loops compatible with the peak and average power needs of the accelerator tanks. Two such loops have ben developed in the Accelerator Technology (AT) Division at Los Alamos and are now part of the general accelerator inventory. One loop is of small size, appropriate for radio-frequency quadrupole (RFQ) injector-accelerators, and is rated at 500-kW peak, 2-ms pulse length and 5% duty factor. The other loop is a 1-MW design, physically larger, also rated at 2-ms pulse length and 5% duty factor. The 1-MW drive loop uses a flat-disk ceramic window. The 500-kW loop as developed can use either a flat disk window or a special $\lambda 2$ window module available from Oak Ridge National Laboratory (ORNL). The purpose of this note is to describe the design of these loops and the tests performed on them so that they might be used by design engineers with appropriate applications.

37429 **(RI—194) Neutron flux generation of the cyclotron MGTs-20.** Nemilov, Yu.A.; Selitskij, Yu.A.; Funshtejn, V.B.; Khlebnikov, S.V. (Radievyj Inst., Leningrad (USSR)). 1987. 37p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702952/JAW.

Analysis of reactions for production of monoenergetic neutrons and neutrons of continuous energy spectrum on the cyclotron MGTs-20 is performed. Neutron fluxes are calculated. Optimum irradiation conditions and target materials for production of intensive fluxes of monoenergetic neutrons with low neutron background are recommended. 35 refs.; 23 figs.; 6 tabs.

37430 **(SAND—87-3007C) Long-pulse, high-power vircator experiments.** Coleman, P.D.; Aurand, J.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-8805132—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011787/JAW.

From 4. national high power microwave conference; Monterey, CA, USA (9 May 1988).

An experiment designed to achieve long pulse virtual cathode oscillator (VCO) operation at ~ 700 MHz is described. Low frequency operation allowed operating at large A-K gaps and low current densities which facilitated the 800 ns pulsewidth operation. The VCO was configured in a 91 cm diameter drift tube and consisted of a 76 cm diameter planar cathode separated from an anode screen by an A-K gap that was varied from 5 to 10 cm. The diode was directly driven by a Marx generator with a resultant A-K voltage of 350 kV. Power was extracted axially from the cylindrical waveguide through a Lexan window. Application of a transverse magnetic field downstream of the virtual cathode swept the beam into the wall. This method of dumping the beam avoided plasma formation at the window and a resultant shortening of the radiated pulse. The frequency was observed to chirp from 600 to 800 MHz. The radiation pattern was measured by a seven element B-dot array located 2.4 m from the exit window. Comparison of these patterns to computer code predictions indicated a mix of TM_{01} and TM_{02} modes.

37431 **(SLAC—327) Health physics manual of good practices for accelerator facilities.** Casey, W.R.; Miller, A.J.; McCaslin, J.B.; Coulson, L.V. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Brookhaven National Lab., Upton, NY (USA); Los Alamos National Lab., NM (USA); Lawrence Berkeley Lab., CA (USA); Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1988. Contract AC03-76SF00515. 140p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88010816/JAW.

It is hoped that this manual will serve both as a teaching aid as well as a useful adjunct for program development. In the context of application, this manual addresses good practices that should be observed by management, staff, and designers since the achievement of a good radiation program indeed involves a combined effort. Ultimately, radiation safety and good work practices become the personal responsibility of the individual. The practices presented in this manual are not to be construed as mandatory rather they are to be used as appropriate for the specific case in the interest of radiation safety. As experience is accrued and new data obtained in the application of this document, ONS will update the guidance to assure that at any given time the guidance reflects optimum performance consistent with current technology and practice.The intent of this guide therefore is to: define common health physics problems at accelerators; recommend suitable methods of identifying, evaluating, and managing accelerator health physics problems; set out the established safety practices at DOE accelerators that have been arrived at by consensus and, where consensus has not yet been reached, give examples of safe practices; introduce the technical literature in the accelerator health physics field; and supplement the regulatory documents listed in Appendix D. Many accelerator health physics problems are no different than those at other kinds of facilities, e.g., ALARA philosophy, instrument calibration, etc. These problems are touched on very lightly or not at all. Similarly, this document does not cover other hazards such as electrical shock, toxic materials, etc. This does not in any way imply that these problems are not serious. 160 refs.

37432 **(UCRL—97216) The two-beam accelertor.** Sessler, A.M.; Hopkins, D.B. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 7p. (CONF-870632—15). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011352/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

The Two-Beam Accelerator (TBA) consists of a long high-gradient accelerator structure (HGS) adjacent to an equal-length Free Electron Laser (FEL). In the FEL, a beam propagates through a long series of undulators. At regular intervals, waveguides couple microwave power out of the FEL into the HGS. To replenish energy given up by the FEL beam to the microwave field induction accelerator units are placed periodically along the length or the FEL. In this manner it is expected to achieve gradients of more than 250 MV/m and thus have serious option for a 1 TeV {times} 1 TeV linear collider. The state of present theoretical understanding of the TBA is presented with particular emphasis upon operation of the "steady-state" FEL, phase and amplitude control of the rf wave, and suppression of sideband instabilities. Experimental work has focused upon the development of a suitable HGS and the testing of this structure using the Electron Laser Facility (ELF). Description is given of a first test at ELF with a seven-cell $2\pi/3$ mode structure which without pre-conditioning and with a not-very-good vacuum nevertheless at 35 GHz yielded an average accelerating gradient of 180 MV/m.

37433 **A scientific workstation operator-interface for accelerator control.** Paxson, V.; Jacobson, V.; Theil, E.; Lee, M.; Clearwater, S. (Lawrence Berkeley Lab., Berkeley, CA 94720 (US)). pp 556-558 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00098;AC03-76SF00515.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Research in human factors has demonstrated that people use computers more efficiently and effectively if they have a highly visual interface to the machine. Today's scientific workstations provide sufficient power to implement such interfaces. By using these workstations, an operator interface for an accelerator control system can be built which is powerful, flexible, and easy to learn. The authors discuss such a system currently being developed on a Sun-3 workstation. The system is designed as a set of building blocks which can be run independently or linked together. This toolbox approach gives the operator the ability to execute precisely those programs needed for the task at hand. Each program runs in a separate window and communicates with other running programs via a common data base. When the operator makes a change in one window, the effects are then shown in the other windows.

37434 **Some applications of AI to the problems of accelerator physics.** Higo, T.; Shoaee, H.; Spencer, J.E. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 701 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Failure of orbit correction schemes to recognize betatron oscillation patterns obvious to any machine operator is a good problem with which to analyze the uses of Artificial Intelligence and the roles and relationships of operators, control systems and machines. Because such error modes are very common, their generalization could provide an efficient machine optimization and control strategy. A set of first-order, unitary transformations connecting canonical variable through measured results are defined which can either be compared to design for commissioning or to past results for 'golden orbit' operation. Because these relate directly to hardware variables, the method is simple, fast and direct. It has implications for machine design, controls, monitoring and feedback. Chronological analysis of such machine signatures can predict or provide a variety of information such as mean time to failure, failure modes and fast feedback or feedforward for optimizing figures of merit such as luminosity or current transmission. The use of theoretical and empirical scaling relations for such problems is discussed in terms of various figures of merit, the variables on which they depend as well as their functional dependences.

37435 **Programmable master-timer system.** Potter, J.M.; Barnes, M.L.; Bjorklund, E.A. (Los Alamos National Lab., Los Alamos, NM (US)). pp 628-630 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Clinton P. Anderson Meson Physics Facility (LAMPF) master-timer system provides a 96-channel timing solution of programmable signals and eight predefined system signals required for accelerator operation. Each signal may differ in delay, length, and rate of repetition. Timing solutions are calculated in the LAMPF

central control computer, a VAX 11/780, and down-loaded to the master-timer computer, a μVAX-II. The one second timing solution consists of 120 macropulses synchronized to the zero crossing of the ac line. The output signal resolution is one microsecond. This CAMAC-based system is implemented in a dual configuration to ensure versatility and reliability. Each subsystem provides two, 96-channel timing solutions. Any of the four master-timer solutions can be loaded, verified, and then synchronously selected. If the μVAX-II discovers a timing error during self-testing, it automatically switches to a valid solution. Once loaded, the system will continue to run without computer intervention. The master-time system has the capability of local control and of displaying current status information. Adaptability, reliability, and self-testing assure that the LAMPF master-timer system will keep pace with future requirements.

37436 **Present and future superconducting linacs.** Bollinger, L.M. (Argonne National Lab., Argonne, IL (US)). pp 233-238 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper is a survey of superconducting linacs designed for heavy-ion acceleration and a brief discussion of future prospects. Eight such machines are in operation or under construction, and others are being planned. Most of these linacs function as energy boosters for ions from tandem electrostatic accelerators and are designed to provide output beams or relatively low energy but very good quality. The short independently-phased accelerating structures of the linacs involved in these tandem-linac systems cover the velocity range $0.4 \leq \beta \leq 0.3$. In a recent development, the technology is being extended down to ions with $\beta < 0.01$ in order to eliminate the need for the tandem injector. The main design features of the various heavy-ion linacs are summarized, and differences from superconducting linacs for electron acceleration are noted.

37437 **Collective acceleration of protons by the plasma waves in a counterstreaming electron beam.** Yan, Y.T. (Applied Theoretical Physics Div., Los Alamos National Lab., Los Alamos, NM (US)). pp 175-177 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A novel advanced accelerator is proposed. The counterstreaming electron beam accelerator relies on the same physical mechanism as that of the plasma accelerator but replaces the stationary plasma in the plasma accelerator with as magnetized relativistic electron beam, drifting antiparallel to the driving source and the driven particles, as the wave supporting medium. The plasma wave in a counterstreaming electron beam can be excited either by a density-ramped driving electron beam or by properly beating two laser beams. The fundamental advantages of the counterstreaming electron beam accelerator over the plasma accelerator are a loner and tunable plasma wavelength, a longer pump depleting length or a larger transformer ratio, and easier pulse shaping for the driving source and the driven beam. Therefore, the energy gain of the driven particles can be greatly enhanced whereas the trapping threshold can be dramatically reduced, thus admitting the possibility for proton acceleration.

37438 **Modifications to the SSC lattice.** Garren, A.A.; Johnson, D.E. (SSC Central Design Group, c/o Lawrence Berkeley Lab., Berkeley, CA (US)). pp 163-165 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Possible modifications of the lattice described in the Superconducting Super Collider Conceptual Design Report of March 1986 have been considered and are presented below. One potential modification to the lattice is to change the arc cells in betatron phase advance from 60° t 90°, and to lengthen them to include six rather than five dipoles per half cell. Another related change is to make the dispersion suppressors shorter, and to include longer drift spaces for scrapers and detectors.

37439 **Antiproton acceleration in the Fermilab Main Ring and Tevatron.** Martin, P.; Dinkel, J.; Ducar, R.; Kerns, C.; Kerns, Q.; Meisner, K.; Miller, H.W.; Reid, J.; Tawzer, S.; Wildman, D. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 47-49 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The operation of the Fermilab Main Ring and Tevatron rf systems for colliding beams physics is discussed. The changes in the rf feedback system required for acceleration of antiprotons, and the methods for achieving proper transfer of both protons and antiprotons are described. Data on acceleration and transfer efficiencies are presented.

37440 **Rf-driver linear colliders.** Wilson, P.B. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 53-58 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The next generation of linear collider after the SLC (Stanford Linear Collider) will probably have an energy in the range 300 GeV-1 TeV per linac. A number of exotic accelerating schemes, such as laser and plasma acceleration, have been proposed for linear colliders of the far future. However, the technology which is most mature and which could lead to a collider in the above energy range in the relatively near future is the rf-driven linac, in which externally produced rf is fed into a more or less conventional metallic accelerating structure. Two basic technologies have been proposed for producing the required high peak rf power: discrete microwave power sources, and various two-beam acceleration schemes in which the rf is produced by a high current driving beam running parallel to the main accelerator. The current status of experimental and analytic work on both the discrete source and the two-beam methods for producing rf are discussed. The implications of beam-beam related effects (luminosity, disruption and beamstrahlung) for the design of rf-driven linear colliders are also considered.

37441 **Non-plasma based advanced methods of acceleration.** Siemann, R.H. (Accelerator Div., Fermi National Accelerator Lab., Batavia, IL (US)). pp 59-62 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The development of advanced acceleration mechanisms provide new capabilities for science. At the present time, discussions are centered on particle physics where advanced accelerators are the only route to electron-positron collisions at energies significantly above that of LEP. Cost effectiveness in this application leads to requirements which can be stated roughly as: i. high acceleration gradient for a reasonable length machine, ii. small transverse emittances for a small collision spot, iii. small longitudinal emittance to minimize chromatic aberrations while working in the quantum beamstrahlung regime, iv. stable, reproducible operation. These requirements may be unique, and an acceleration technique inappropriate for this may be suitable in some other application. However, since end-use requirements have an important influence and these have been enumerated only for high energy linear colliders, this paper concentrates on advanced accelerators for particle physics. In a linear collider the beam power, center-of-mass energy, luminosity,

and beamstrahlung parameter fix the longitudinal and transverse beam dimensions, the collision frequency, and number of particles. The accelerator must be designed to minimize costs while reaching the needed energy with the needed beam quality.

37442 **Overview of plasma based accelerating schemes.** Clayton, C.E. (Univ. of California, Los Angeles, Los Angeles, CA (US)). pp 63-67 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The group of accelerator concepts which exploit the ability of plasma to support extremely high electric fields are reviewed here. The topic of Plasma Accelerators is introduced by a general discussion of the relativistic plasma waves which provide the accelerating structure for the two most studied plasma accelerator concepts; namely, the Beatwave and Wakefield Accelerators. Some recent results on beam loading, extraction efficiency, and emittance growth in these structures are also discussed. Current research highlights in the several accelerator concepts will be presented as well as some other uses for plasma in the accelerator field such as plasma lenses and plasma wigglers.

37443 **An advanced hadron facility: A combined kaon factory and cold-neutron source.** Thiessen, H.A. (Los Alamos National Lab., Los Alamos, NM (US)). pp 86-89 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors present a concept for an advanced hadron facility consisting of a combined kaon factory and second generation spallation source. The authors' concept consists of a 1.2 GeV superconducting H/sup -/ afterburner to bring the LAMPF energy up to 2 GeV, a multi-ring 2 GeV compressor, a shared cold-neutron and stopped-pion neutrino source, a 60 GeV 25 μAmp 6 Hz proton synchrotron, and kaon and proton experimental areas. The authors discuss the considerations which led to this concept. The authors summarize recent results of r and d work on components for rapid-cycling synchrotrons. Finally, they mention briefly the possibilities for a pion linac at LAMPF.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 37324, 37513, 37520, 37532

37444 **(ANL-HEP-CP—88-17) Commissioning of polarized-proton and antiproton beams at Fermilab.** Yokosawa, A. (Argonne National Lab., IL (USA)). 4 May 1988. Contract W-31-109-ENG-38. 6p. (CONF-880399—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012045/JAW.

From 23. Rencontre de Moriond: current issues in hadron physics; Les Arcs, France (13 Mar 1988).

The author described the polarized-proton and polarized-antiproton beams up to 200 GeV/c at Fermilab. The beam line, called MP, consists of the 400-m long primary and 350-m long secondary beam line followed by 60-m long experimental hall. We discuss the characteristics of the polarized beams. The Fermilab polarization projects are designated at E-581/704 initiated and carried out by an international collaboration, Argonne (US), Fermilab (US), Kyoto-Kyushu-Hiroshima-KEK (Japan), LAPP (France), Northwestern University (US), Los Alamos Laboratory (US), Rice (US), Saclay (France), Serpukhov (USSR), INFN Trieste (Italy), and University of Texas (US).

37445 **(BNL—41328) Effect of coupling on intrabeam scattering.** Parzen, G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 3p. (CONF-880695—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012141/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The effect of coupling between horizontal and vertical betatron oscillations on the growth of a beam due to a intrabeam scattering has been studied. It was suggested that the presence of coupling may reduce the effects of intrabeam scattering. A procedure is outlined for revising intrabeam scattering theory to include coupling. There is one case where a plausible solution is not difficult to find, and this is the case of complete coupling. In this case, although coupling reduces the initial horizontal growth rate by a factor of 2, the final size of the beam after many hours is reduced by about 15%. An invariant is found that relates the energy spread and the transverse beam size that is valid at high energies and for the case of complete coupling.

37446 **(BNL—41360) Nonlinear synchrotron motion near transition energy in RHIC.** Lee, S.Y.; Wei, J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-880695—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012142/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

A tracking program to study the nonlinear effect of the longitudinal motion for particles in the circular accelerator has been written. When the RF voltage $V_0 = 1.2$ MV is used, we find that $\gamma_{sub\ T}$ jump, $\gamma_{sub\ T}$ or faster acceleration rate, γ is needed in RHIC. The simulation result can be understood analytically via the nonlinear equation of motion. For the $\gamma_{sub\ T}$ jump scheme, there is little bunch shape dilution or deformation in the transition energy crossing. At a bunch area of 0.3 ev-sec/amu, $\Delta\gamma_{sub\ T} = 0.6$ in 30 msec is satisfactory to eliminate the beam loss and preserve the bunch area. By manipulating the momentum aperture, γ can be increased substantially at the transition energy region. To eliminate beam loss, +/- 0.8% of momentum aperture is needed. On the other hand, when the RF voltage is reduced to 100KV, while maintaining the same acceleration rate, the bunch survival rate across the transition energy is dramatically increased. This is resulted from both smaller momentum spread and longer adiabatic time at the transition energy region due to the smaller voltage.

37447 **(BNL—41363) Beam-beam interactions and luminosity considerations in RHIC.** Rhoades-Brown, M.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-880695—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012138/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The performance of the RHIC machine is largely determined by the intrabeam scattering process. However, beam-beam interactions due to both nuclear scattering and intrinsic Coulomb excitation of the heavy ions will result in beam loss and luminosity reductions. The transverse electric field, responsible for Coulomb excitation, is multiplied by a Lorentz Gamma factor at relativistic energies. For ^{197}Au beams in RHIC (Lab. Frame) this factor is 108. Once Coulomb excitation has occurred, the nucleus may fragment or emit a proton, and thus be lost from the beam. Estimates of the beam lifetime will be presented, based on perturbative calculations for the Coulomb excitation process. In addition, di-lepton production from the enormous transverse electric field will be discussed and related to the more general luminosity questions.

37448 **(CONF-880601—8) The modified high-energy transport code, HETC, and design calculations for the SSC [Superconducting Super Collider].** Alsmiller, R.G. Jr.; Alsmiller, F.S.; Gabriel, T.A.; Hermann, O.W.; Bishop, B.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88004483/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The proposed Superconducting Super Collider (SSC) will have two circulating proton beams, each with an energy of 20 TeV. In order to perform detector and shield design calculations at these higher energies that are as accurate as possible, it is necessary to incorporate in the calculations the best available information on

differential particle production from hadron-nucleus collisions. In this paper, the manner in which this has been done in the High-Energy Transport Code HETC will be described and calculated results obtained with the modified code will be compared with experimental data. 10 refs., 1 fig.

37449 **(ENEA-RT-TIB—87-35) Analytical treatment of the FEL pulse dynamics in the long bunch limit. Pt III.** Dattoli, G.; Torre, A.; Mezi, L.; Gallardo, J.C. (ENEA, Frascati (Italy). Centro Ricerche Energia; Brookhaven National Lab., Upton, NY (USA)). (ENEA, Rome (Italy)). 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702852/JAW.

The FEL pulse dynamics is investigated in terms of stationary solutions of super mode type. A fully analytical investigation is carried out and it is shown that, within the approximation of long bunch limit, FEL super modes realize a biorthogonal basis. The relevance of this result to treat the optical field evolution with a preinjected signal or higher order perturbation is also discussed. Finally it is shown that the present analytical method is in very good agreement with previous numerical predictions.

37450 **(IFVE-OUNK—87-71) Effect of synchrotron beam parameters on the spectrum of its electromagnetic radiation in nonuniform magnetic field.** Smolyakov, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702862/JAW.

Submitted to the journal Zh. Tekh. Fiz. .

The dipole electromagnetic radiation of a beam in the synchrotron passing through the rapid azimuthally nonuniform magnetic field is studied. The spectral density of the radiation is shown to be greater for the particles moving nearer to the magnetic system poles. The nature of a such growth of the spectral-angular density of radiation is found to be independent of the certain type of the plane magnetic system (short magnets, dipole magnet edge, plane ondulator). The formula for spectral-angular raiation density versus particles transverse coordinate is obtained. Some features of the beam transverse profile diagnostics by means of beam radiation in ondulator fields and short magnets are analysed. 25 refs.; 1 fig.

37451 **(INFN-LNF—88-04(R)) Infrared free electron laser on the superconducting linac LISA.** Castellano, M. (Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702864/JAW.

The main parameters of a Free Electron Laser covering the infrared wavelength region and using the high quality electron beam produced by the Superconducting Linac LISA in development at the Frascati National Laboratories are breafly reviewed. Some considerations of the effects of the FEL interaction on a possible electron beam energy recover are also presented.

37452 **(JINR—R-9-87-268) Calculations of high-frequency parameters of disc-loaded waveguides.** Kaschiev, M.S.; Mamonov, V.N.; Obukhov, Yu.L.; Reshetnikova, K.A.; Rubin, S.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702178/JAW.

Radio-technical parameters of a disc-loaded waveguide suitable for modeling two-beam acceleration are designed. Two series of calculations using the finite element method (MULTIMODE program) and restricted region method (ALF program) lead to coinciding resonance frequencies for rectangular-disc waveguide. The MULTIMODE program package is also used for the numerical simulation of the rounded-edge-disc waveguide, the field distribution picture and several energy parameters of the designed system. 10 refs.; 6 figs.; 4 tabs.

37453 **(JINR-R—11-87-349) On an approach to solving the charged particle motion differential equations in synchrotron.** Yudin, I.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702939/JAW.

Submitted to the Organizing Committee of All-Union Conference New approach to differential equation solution, Drogobych, 17 - 21 May 1987.

A numercial solution of a system of differential equations describing transverse (betatron) oscillations of charged particles when they pass through a bending magnet which field contains, besides the dipole component, the amplitude of 3th, 5th and 7th Fourier harmonics is obtained with a high accuracy by means of constructed the Runge-Kutta type algorithm of the 5th order. An analytical dependence of the obtained numerical solution (final phase coordinates x/sub K/, x'/sub K/, y/sub K/, y'/sub K/) upon the initial phase coordinates and magnetic field parameters is proposed. Program realization of the proposed method for solving differential equations of charged particle motion in the accelerator-synchrotron is developed. 14 refs.; 3 figs.; 1 tab.

37454 **(LA-UR—88-1476) Performance of the Los Alamos expanding telescope.** Dombeck, T.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-880695—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010924/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

An expanding telescope can produce a very low divergence particle beam, provided that the beam optics have sufficient quality in order not to introduce large aberrations. Even as late as two years ago there were no theoretical beamline codes, and little experimental work that could describe the third-order aberrations introduced by an expanding telescope. A project was undertaken at Los Alamos National Laboratory to perform these calculations, and to build a telescope to confirm the predictions. It was installed at Argonne National Laboratory during the summer of 1987 and tested in a 50 MeV H/sup {-/} beam. The telescope consisted of a singlet eyepiece and triplet objective lens with a twenty times magnification. It performed to the design specifications of twenty-five micro-radians beam divergence with a parallel beam focus. The measured geometric aberrations were found to be in agreement with the computer calculations.

37455 **(LA-UR—88-1544) PARMILA [Phase And Radial Motion In Linear Accelerators]: An introduction.** Boicourt, G.P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 23p. (CONF-880178—2). NTIS, PC A03;3. Order Number DE88011050/JAW.

From Workshop on accelerator and beam optics codes; San Diego, CA, USA (19 Jan 1988).

This is a tutorial overview of the PARMILA drift-tube linac beam-dynamics code. First discussed are what PARMILA is and what it is used for. Its origins are discussed. What PARMILA does and how it does its tasks are described. One of the major uses of PARMILA is for the evaluation of effects produced by errors in construction and deviations from design operating conditions. In this connection, a few words are said about what errors PARMILA is able to handle. A section on user friendliness is followed by a few words on the code's accuracy. Finally, some options and improvements are proposed.

37456 **(LA-UR—88-1545) Moment invariants for particle beams.** Lysenko, W.P.; Overley, M.S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-880178—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011052/JAW.

From Workshop on accelerator and beam optics codes; San Diego, CA, USA (19 Jan 1988).

The rms emittance is a certain function of second moments in 2-D phase space. It is preserved for linear uncoupled (1-D) motion. In this paper, the authors present new functions of moments that are invariants for coupled motion. These invariants were computed symbolically using a computer algebra system. Possible

applications for these invariants are discussed. Also, approximate moment invariants for nonlinear motion are presented.

37457 (LA-UR—88-1690) Multipole correction in large synchrotrons. Neuffer, D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-8804111—2; CONF-8804111—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010949/JAW.

From 2. ICFA advanced beam dynamics; Lugano, Switzerland (11 Apr 1988).

A new method of correcting dynamic nonlinearities due to the multipole content of a synchrotron such as the Superconducting Super Collider is discussed. The method uses lumped multipole elements placed at the center (C) of the accelerator half-cells as well as elements near the focusing (F) and defocusing (D) quads. In a first approximation, the corrector strengths follow Simpson's Rule. Correction of second-order sextupole nonlinearities may also be obtained with the F, C, and D octupoles. Correction of nonlinearities by about three orders of magnitude are obtained, and simple solutions to a fundamental problem in synchrotrons are demonstrated. Applications to the CERN Large Hadron Collider and lower energy machines, as well as extensions for quadrupole correction, are also discussed.

37458 (LA-UR—88-1734) Coupled-bunch instabilities in RHIC. Colton, E.; Gianfelice, E.; Bisognano, J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 15p. (CONF-880335—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010931/JAW.

From Workshop on the relativistic heavy ion collider performance; Upton, NY, USA (21 Mar 1988).

We used the program ZAP to evaluate the coupled-bunch modes for the case of 57 equally spaced bunches with the Sacherer-Zotter formalism assuming parabolic bunches. The sources of coupling impedances assumed were space charge, resistive wall, broadband, and rf cavity fundamental and parasitic modes. Generally the studies assumed a stainless steel vacuum chamber, but we did perform a comparison run using a stainless steel chamber internally coated with a thin cold copper layer. These latter investigations were motivated by the proposal for coating which would reduce parasitic wall heating in the vacuum chambers in the superconducting dipoles. 10 tabs.

37459 (LBL—24519) Heavy ion fusion accelerator research (HIFAR) year-end report, April 1, 1987-September 30, 1987. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 33p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008464/JAW.

The basic objective of the Heavy Ion Fusion Accelerator Research (HIFAR) program is to access the suitabilty of heavy ion accelerators as igniters for Inertial Confinement Fusion (ICF). A specific accerelator techonolgy, the induction linac, has been studied at the Lawerence Berkeley Laboratory and has reached the point at which its viability for ICF applications can be assessed over the next few years. The HIFAR program addresses the generation of high-power, high-brightness beams of heavy ions, the understanding of the scaling laws in this novel physics regime, and the vadidation of new accelerator strategies, to cut costs. The papers in this report that address these goals are: MBE-4 mechanical progress, alignment of MBE-4, a compact energy analyzer for MBE-4, Cs^+ injector modeling with the EGUN code, an improved emittance scanning system for HIFAR, 2-MV injector, carbon arc source development, beam combining in ILSE, emittance growth due to transverse beam combining in ILSE - particle simulation results, achromatic beam combiner for ILSE, additional elements for beam merging, quadrupole magnet design for ILSE, and waveforms and longitudinal beam-parameters for ILSE.

37460 (UUIP—1139) Manual to the MAXRAY program library for reflective and dispersive ray tracing. Svensson, S.; Nyholm, R. (Uppsala Univ. (Sweden). Inst. of Physics). Jul 1985. 68p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752513/JAW.

A general ray tracing program package for reflective and dispersive X-ray optics is described. The package consists of a number of subroutines written in FORTRAN 77 code giving the necessary tools for ray tracing. The program package is available on request from the authors. (authors).

37461 Experimental observation of plasma wake-field acceleration. Rosenzweig, J.B.; Cline, D.B.; Cole, B.; Figueroa, H.; Gai, W.; Konecny, R.; Norem, J.; Schoessow, P.; Simpson, J. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **61**: No. 1, 98-101(4 Jul 1988).

We report the first experimental test of the physics of plasma wake-field acceleration performed at the Argonne National Laboratory Advanced Accelerator Test Facility. Megavolt-per-meter plasma wake fields are excited by an intense 21 MeV, multipiscosecond bunch of electrons in a plasma of density n/sub e/≃10/sup 13/ cm/sup -3/, and probed by a low-intensity 15-MeV witness pulse with a variable delay time behind the intense bunch. Accelerating and deflecting wake-field measurements are presented, and the results compared to theoretical predictions.

37462 Parametric growth of space charge waves using a self-biased electrostatic wiggler. Anselmo, A.; Nation, J.A. (Laboratory of Plasma Studies and School of Electrical Engineering, Cornell University, Ithaca, New York 14853-5401). *Physics of Fluids;* **31**: No. 7, 2037-2046(Jul 1988).

An investigation is reported on the use of parametric scattering from an electrostatic wiggler for the growth of space charge waves. This investigation extends previous work on slow space charge wave generation and propagation in inhomogeneous waveguides. Observations show that the scattering technique may be used for the growth of large amplitude waves and that this technique permits wave growth at all values of interest for the ratio of beam to limiting current.

37463 Monitoring the beam position in the SLC interaction region. Denard, J.C.; Bowden, G.B.; Oxoby, G.J.; Pellegrin, J.L.; Ross, M.C. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 686-688 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Stanford Linear Collider requires special Beam Position Monitors near the Interaction Point (IP) to bring the two beams (e/sup +/ and /sup e-/) into collision. These beams pass through two monitors on each side of the IP with a short time separation (about 20 and 50ns). The mechanics of the monitors as well as the electronics will be described. In order to bring beams of several microns diameter into collision at the IP, these monitors measure beam deflection induced by the presence of the opposite beam.

37464 Performance of wire scanner beam profile monitors to determine the emittance and position of high power CW electron beams of the NBS-Los Alamos racetrack microtron. Cutler, R.I.; Owen, J.; Whittaker, J. (National Bureau of Standards, Gaithersburg, MD (US)). pp 625-627 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The NBS-LANL Race Track Microtron (RTM) injector produces a sub-millimeter diameter, 600 μA, 5 MeV CW electron beam. In order to steer and focus this electron beam and to measure its emittance and energy spread, a system of wire scanner beam profile monitors has been developed. Three wire scanners are mounted in a straight line with approximately one meter spacing for emittance measurements. The fourth wire scanner is positioned after a 45° bending magnet for energy spread measurements.

37465 **Time dependent chromaticity changes in the Tevatron.** Finley, D.A.; Edwards, D.A.; Hanft, R.W.; Johnson, R.; McInturff, A.D.; Strait, J. (Fermilab, Batavia, IL (US)). pp 151-153 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Tevatron Collider energy is held constant at 150 GeV for some time while proton and antiproton bunches are injected prior to acceleration and storage. Under these conditions the machine chromaticity has been observed to change by as much as 70 units over the course of several hours. The data are consistent with a decay of the sextupole component of the 774 superconducting dipoles in the ring. Measurements of individual magnets in the Magnet Test Facility show similar behavior. An operating procedure has been devised to compensate for the chromaticity changes which gives a satisfactory beam lifetime.

37466 **Wave growth technique for collective wave accelerators.** Anselmo, A.P.; Nation, J.A. (Lab. of Plasma Studies and School of Electrical Engineering, Cornell Univ., Ithaca, NY (US)). pp 157-159 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The use of parametric scattering as a means of space charge wave growth for a converging guide, ion accelerator system is discussed. A 400-600 keV, 1.5-30 kA electron beam is passed through a self biasing, electrostatic wiggler in order to grow both slow and fast space charge waves. The authors present measurements of the wave frequency and associated wave fields as a function of the equilibrium. Furthermore, a calculation of the wave kinetic power flow and wave electromagnetic power flow is used to estimate the achievable axial electric field.

37467 **Transverse focussing using plasma wake fields.** Cline, D.B.; Cole, B.; Rosenzweig, J.; Norem, J. (Univ. of Wisconsin, Madison, WI (US)). pp 154-156 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Dense particle beams travelling in plasmas can produce very high electric and magnetic fields, and these fields can be used to accelerate and focus particles. The effects on trailing beams and self focusing can be strong and nonlinear. This paper discusses two aspects of self pinching beams: 1) the production of beams which do not self pinch, and 2) a short focal length plasma lens which uses self pinching to reduce beam sizes at the interaction point of a linear collider. As an example, the authors consider a final focus system for the Stanford Linear Collider, considering plasma production, vacuum system and backgrounds, and show how the luminosity could be increased using this system. The authors also discuss experimental tests of the plasma lens concept.

37468 **The Ultralac: A collective wave accelerator for ultrarelativistic particles.** Nation, J.A.; Anselmo, A.P. (Lab. of Plasma Studies and School of Electrical Engineering, Cornell Univ., Ithaca, NY (US)). pp 145-147 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Collective wave accelerator schemes utilizing slow waves on an electron beam have an upper energy limit on the load particles set by the drive beam velocity. Typical intense electron beams operating near limiting current have drift velocities between 0.7c and 0.9c, setting an energy limit for protons of about 1 GeV. In order to collectively accelerate electrons or ions aboue this limit, the drive wave must have a phase velocity greater than electron beam velocity. The Ultralac concept utilizes the fast upper hybrid wave for particle acceleration. It has a phase velocity that is bounded only in the lower limit by the electron drift velocity. Calculations are presented showing the operating parameters of such a device including beam and wave parameters and achievable field gradients, load particle current limits and particle focusing.

37469 **Some experiences from the commissioning program of the SLC arcs.** Fischer, G.E.; Brown, K.L.; Bulos, F.; Fieguth, T.; Hutton, A.; Murray, J.J.; Toge, N.; Weng, W.T.; Wiedemann, H. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 139-141 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The SLC Arc System is designed to transport beams of electrons and positrons from the end of the SLAC Linac to the beginning of the Final Focus System where they are made to collide head on. To minimize phase space dilution caused by quantum processes in the synchrotron radiation energy loss mechanism, the bending radii are large (279 m) and very high gradient (n = 32824) AG cells are arranged in trains of low dispersion, terrain following achromats. First experiences in operating a system of over 900 magnets, each with beam position monitors and corrector magnet movers, spanning 9000 feet, are described.

37470 **A very large β interaction region for the SSC.** Groom, D.E.; Garren, A.A.; Johnson, D.E. (SSC Central Design Group, Lawrence Berkeley Lab. 90-4040, Berkeley, CA (US)). pp 97-99 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Measurements of the p-p elastic scattering cross section into the Coulomb scattering region are important for determining the total p-p cross section, measuring the slope of the elastic cross section with momentum transfer, and normalizing the luminosity of the machine. At SSC energies, Coulomb scattering dominates only below 1 μrad. For the nominal SSC emittance (ϵ/sub N/ = 10/sup -6/m-rad), the angular spread of the beam is 6.8 x $\sqrt{1}$ m/β^* μrad. For the contribution of this spread to be comparable to the desired experimental resolution, the authors require $\beta^* \simeq 4000$ m. Moreover, to scan the cross section at larger angles it is desirable to tune β^* to smaller values. These requirements result in stringent IR design criteria: Crossing angles must be large to avoid disruption at bunch encounters, but not too large, in order to avoid synchro-betatron oscillations. At the same time, beams must pass through common triplet quadrupoles to be sufficiently separated for separate quadrupoles.

37471 **A low voltage repeater for studies of e-beam wave interactions.** Ivers, J.D.; Zhang, Y.Z.; Anselmo, A.; Nation, J.A. (Lab. of Plasma Studies and School of Electrical Engineering, Cornell Univ., Ithaca, NY (US)). pp 91-93 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A long pulse (350 nsec.), low energy 40-80 kV), electron beam repeater has been built for the study of various electron beam wave interactions. The authors' primary interest is in the fast upper hybrid mode, which they wish to excite such that its phase velocity is equal to the speed of light and hence, is suitable for electron acceleration. The repeater is capable of a 1 Hz pulse rate at current levels of 1.4 kA, well above the space charge current limits of the experiments. Electron beam confinement is provided by a pulsed axial magnetic field of 300 to 1500 Gauss. A study of beam charac-

teristics using radial electric field probes, Faraday cups and Rogowski coils is underway. Results are presented showing the equilibrium beam plasma parameters as a function of the operating conditions. Techniques used for the wave growth are discussed and first results indicated. The wave frequency is chosen to be below the electromagnetic cutoff frequency of the empty guide. Results from the experiment will enable them to scale future experiments for 0.5 MeV, 2.0 kA beams supporting upper hybrid waves in the K-band. These high frequency waves on these more intense beams may lead to a high gradient (200 MV/m) electron accelerator.

37472 **Experimental beam dynamics in the SLC linac.** Seeman, J.T.; Campisi, I.E.; Hermannsfeldt, W.; Lee, M.; Petersen, A.; Tsang, D.; Abrams, G.S.; Adolphsen, C.; Soderstrom, E. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 73-76 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The component installation for the upgrade of the three-kilometer linac for the SLAC Linear Collider (SLC) was completed in late summer 1986. The system status and measurements of beam properties made during commissioning are described in this paper. Further linac measurements are reviewed in companion papers. In summary, a low-emittance electron beam from a damping ring has been accelerated through the linac and injected into the north SLC Arc with negligible loss. The maximum bunch intensity is 2.9 x 10/ sup 10/ electrons/pulse. A peak particle energy of 53 GeV has been reached. Operation at 47 GeV is now routine. The energy and energy spectrum of the electron beam can be rapidly measured nondestructively at high energy. These signals will be used in a fast feedback system nearing completion. The electron beam can be centered in the accelerator to about 200 μm rms. Slow feedback of the injection position and angle into the linac and injection into the north ARc are operational. Longitudinal and transverse wakefields have been measured and appear to be near expectations. Transverse position measurements at the end of the linac show a 120 μm horizontal and a 30 μm vertical (rms) jitter from pulse to pulse. The spot shape, including the transverse tails, also shows some jitter. The transverse position and shape fluctuations have several sources involving launch instabilities, chromatic effects, RF deflections and lattice mismatches. Continued improvements are expected. These parameter jitters would not preclude collisions. The measured invariant transverse emittances of the beam at 47 GeV are 2 x 10/sup -5/ rm vertically and 12 25 x 10/sup -5/ rm horizontally at 1 x 10/ sup 10/ e/sup -/. The horizontal emittance increases with beam intensity. Damped positrons have been injected into the linac, and trajectory correction is underway.

37473 **Studies of anomalous dispersion in the SLC second order achromat.** Fieguth, T.; Kheifets, S.; Murray, J.J. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 77-79 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Certain causes of anomalous dispersion in the second order achromats of the SLC arcs are investigated. For matched dispersion, transverse displacements of combined function magnets do not introduce anomalous dispersion. This is shown by deriving a non-dispersive condition connecting the average of the matched dispersion function with the quadrupole and sextupole components of the field. In the SLC Arcs, however, the achromats are rolled producing a dispersion mismatch. In this case, the horizontal (vertical) dispersion is affected linearly by vertical (horizontal) displacement of magnets. The integral condition connecting the dipole and quadrupole fields and the matched dispersion is also derived. Combining this with the non-dispersive condition and the analytic expression of the matched dispersion gives two simple relationships for the fields of second order achromats constructed of combined function magnets. The effects of the dispersion mismatch in the SLC Arcs is investigated using computer simulations. The results show that this mismatch will increase the sensitivity to transverse errors. The authors report the effects of certain systematic errors.

37474 **Computer simulation studies of electron beam propagation and collective ion acceleration in vacuum.** Chang, C.R.; Reiser, M. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD (US)). pp 106-108 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The propagation of a relativistic electron beam through plasma into vacuum via collective ion acceleration from the plasma is investigated with a numerical simulation code. Results show dynamic details of virtual cathode formation and the high-energy tail in the ion distribution not noticed previously.

37475 **Stability of the driving bunch in the plasma wakefield accelerator.** Su, J.J.; Dawson, J.M.; Katsouleas, T.; Wilks, S.; Chen, P.; Jones, M.; Keinigs, R. (UCLA, Los Angeles, CA (US)). pp 127-129 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors investigate the stability of the driving electron or positron beam in the plasma wakefield accelerator. Although the beam is subject to self-focusing, filamentation and two stream instability, they find that all of these can be annihilated by introducing thermal energy and an axial magnetic field.

37476 **Observations of the beam-beam interaction.** Seeman, J.T. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 121-153 of Nonlinear dynamics aspects of particle accelerators. Araki, H.; Ehlers, J.; Hepp, K.; Kippenhahn, R.; Weidenmuller, A.; Zittartz, J. New York, NY; Springer-Verlag New York Inc. (1986). (CONF-850114—).

From Joint US/CERN School on Particle Accelerators topical course on non-linear dynamics; Sardinia, Italy (31 Jan 1985).

During the past two and one-half decades a new colliding beam storage ring has been built and commissioned every two years on the average. This rate will continue at least for the next decade. With each new machine there is great excitement for new physics discoveries and there are many challenges for the accelerator builders. One of the challenges is the continual drive to increase the peak and integrated luminosities of these rings. The beam-beam interaction influences directly the luminosity and has been studied extensively. It has resisted complete understanding, both theoretically and experimentally. The primary difficulties are the nonlinearity of the Coulomb force and the bunch shapes (Gaussian), the large number of degrees of freedom (six), and the large numbers of particles involved ($\sim 10^{11}$). The observed complexity of the beam-beam interaction of this paper. The varied observations obtained from many storage rings happen to be sufficiently similar that a prescription can be formulated to describe the behavior of the luminosity as a function of beam current including the peak value. This prescription can be used to interpret various methods for improving the luminosity. Discussion of these improvement methods is accompanied with examples from actual practice. The consequences of reducing the vertical betatron function (one of the most used techniques) to near the value of the bunch length are reviewed. Finally, areas needing further experimental and calculational studies are pointed out as they are uncovered.

37477 Nonlinear beam-beam resonances. Chao, A.W.; Bambade, P.; Weng, W.T. (SSC Central Design Group, Univ. Research Association, c/o Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 77-103 of Nonlinear dynamics aspects of particle accelerators. Araki, H.; Ehlers, J.; Hepp, K.; Kippenhahn, R.; Weidenmuller, A.; Zittartz, J. New York, NY; Springer-Verlag New York Inc. (1986). (CONF-850114—). Contract AC03-76SF00515.

From Joint US/CERN School on Particle Accelerators topical course on non-linear dynamics; Sardinia, Italy (31 Jan 1985).

In a colliding beam storage ring, a major source of nonlinear resonance excitation resides in the beam-beam collisions as the stored beams repeatedly cross each other. During such collisions, particles in each beam see the electromagnetic field generated by the counter rotating beam. The beam-beam collisions therefore perturb the particle motion, causing: 1. the transverse beam size to blow up and los of luminosity; 2. the beam lifetime to be reduced; 3. and rapid beam loss as beam intensity increases beyond a more or less distinct threshold. Considerable efforts, both experimental and theoretical, have brought some insight into the beam-beam instability problem and often led to improvements in luminosity. But the nature of the instability and its associated underlying mechanism(s) are not yet fully understood and remain an outstanding problem for the designers of colliding beam storage rings. To reduce the scope of this lecture, the authors consider only head-on collisions of bunched beams. For the sign convention of the beam-beam force, they assume the two colliding beams to have opposite charges. They also assume that the reader is at least somewhat familiar with Hamiltonian dynamics and some basic facts about the beam-beam interaction. For part of the discussions on coherent beam-beam effects, they assume the reader has some knowledge about the Vlasov equation.

37478 Single particle dynamics and nonlinear resonances in circular accelerators. Ruth, R.D. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 37-63 of Nonlinear dynamics aspects of particle accelerators. Araki, H.; Ehlers, J.; Hepp, K.; Kippenhahn, R.; Weidenmuller, A.; Zittartz, J. New York, NY; Springer-Verlag New York Inc. (1986). (CONF-850114—). Contract AC03-76SF00515.

From Joint US/CERN School on Particle Accelerators topical course on non-linear dynamics; Sardinia, Italy (31 Jan 1985).

The purpose of this paper is to introduce the reader to single particle dynamics in circular accelerators with an emphasis on nonlinear resonances. The authors begin with the Hamiltonian and the equations of motion in the neighborhood of the design orbit. In the linear theory this yields linear betatron oscillations about a closed orbit. It is useful then to introduce the action-angle variables of the linear problem. Next the authors discuss the nonlinear terms which are present in an actual accelerator, and in particular, they motivate the inclusion of sextupoles to cure chromatic effects. To study the effects of the nonlinear terms, they next discuss canonical perturbation theory which leads them to nonlinear resonances. After showing a few examples of perturbation theory, they abandon it when very close to a resonance. This leads to the study of an isolated resonance in one degree of freedom with a 'time'-dependent Hamiltonian. They see the familiar resonance structure in phase space which is simply closed islands when the nonlinear amplitude dependence or the frequency or 'tune' is included. To show the limits of the validity of the isolated resonance approximation, they discuss two criteria for the onset of chaotic motion. Finally, the authors study an isolated coupling resonance in two degrees of freedom with a 'time'-dependent Hamiltonian and calculate the two invariants in this case. This leads to a surface of section which is a 2-torus in 4-dimensional phase space. However, they show that it remains a 2-torus when projected into particular 3-dimensional subspaces and thus can be viewed in perspective.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 37442, 37464, 37573, 37584, 37585, 37880, 37883, 38520, 38785

37479 (AECL—8960) Conceptual design study for the proposed ISOL post-accelerator at TRIUMF. McMichael, G.E.; Chidley, B.G.; Hutcheon, R.M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1985. 67p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702213/JAW.

The proposed TRIUMF ISOL facility will include the capability to accelerate the extracted radioactive heavy ions for use in a wide range of astrophysics experiments. This report presents a conceptual design for such a post-accelerator, with parameters specific to the TRIUMF facility. It features a 4-rod 23 MHz RFQ linac, able to accelerate singly charged ions with masses to 60 amu, from 1 to 60 keVamu, and a 23 MHz DTL for singly charged mass 20 ions (or triply charged ions of mass 60 or less) to complete the acceleration to any desired value in the range 0.265 to 1 MeVamu. Two single gap bucket rotator cavities reduce the energy spread to 1 part in 10^3 over the whole energy range.

37480 (ANL-HEP-CP—88-22) Calculation of higher order modes in the RHIC 27 MHz rf cavity. Schoessow, P. (Argonne National Lab., IL (USA)). May 1988. Contract W-31-109-ENG-38. 6p. (CONF-880335—3-Vugraphs). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012007/JAW.

From Workshop on the relativistic heavy ion collider performance; Upton, NY, USA (21 Mar 1988).

The URMEL code was used to calculate the frequencies, quality factors, and shunt impedances of the lowest modes of the proposed RHIC accelerating cavity. These values can be used as input for the calculation of the longitudinal and transverse coupled-bunch instabilities. The cavity dimensions were taken from the RHIC conceptual design report.

37481 (BNL—41016) A high intensity, low energy, monoenergetic positron beam at the Brookhaven National Laboratory. Weber, M.; Berko, S.; Canter, K.F.; Lynn, K.G.; Mills, A.P. Jr.; Moodenbaugh, A.R.; Roellig, L.O. (City Coll., New York (USA); Brandeis Univ., Waltham, MA (USA); Brookhaven National Lab., Upton, NY (USA); AT and T Bell Labs., Murray Hill, NJ (USA)). 1985. Contract AC02-76CH00016. 7p. (CONF-850118—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007545/JAW.

From 3. international modal analysis conference; Orlando, FL, USA (28 Jan 1985).

This paper describes how a high intensity, low energy, monoenergetic positron beam can be produced from a ^{58}Cu source. 5 refs., 4 figs.

37482 (BNL—41158) The superconducting wiggler beamport at the National Synchrotron Light Source. Thomlinson, W.; Chapman, D.; Gmuer, N.; Lazarz, N. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 19p. (CONF-870610—21). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009160/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

A beamport is currently being instrumented to utilize high energy synchrotron radiation from the superconducting wiggler magnet on the x-ray at the National Synchrotron Light Source. Two independent programs are being developed to run in tandem, non-concurrently, on the central beamline: material sciences on X17B1 and medical research/angiography on X17B2. A high pressure research program will run independently on a side station, X17C. Considerations in the design of the beamline include handling severe power loading, radiation shielding protection and beam energy filtering.

37483 **(BNL—41171) Manually-operated ultra-high-vacuum water-cooled slit mechanism for the U13U wiggler/undulator spectroscopy branch line at the National Synchrotron Light Source.** Hulber, S.L.; Rotela, E.; Shleifer, M. (Brookhaven National Lab., Upton, NY (USA); Department of Energy, Washington, DC (USA). Office of Basic Energy Sciences). Apr 1988. Contract AC02-76CH00016. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012133/JAW.

The authors describe a manually-operated ultra-high-vacuum (UHV) water-cooled slit mechanism. The design, which is based on the use of rigid parallelograms, provides a continuously adjustable bilateral slit opening. The entire mechanism is mounted on an eight-inch Conflat flange with two bellows for cooling water tubes and a linear feedthrough to control the size of the slit opening.

37484 **(BNL—41284) Radio frequency systems for present and future accelerators.** Raka, E.C. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 23p. (CONF-8705288—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010666/JAW.

From 3. workshop on new techniques for future acceleration: RF and microwave systems; Erice, Italy (23 May 1987).

Rf systems are described for the FNAL Main Ring and Tevatron Ring, CERN SPS and LEP, and HERA proton acceleration system, CERN PS e^+ e/sup minus/ acceleration system, and CERN EPA monochromatic cavity. Low impedance rf systems in CERN ISR, the Brookhaven CBA, and SSC are also discussed.

37485 **(BNL—41371) Roles of scattered radiation in SRIXE.** Hanson, A.L. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-8804154—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012140/JAW.

From 23. school on physics; Zakopane, Poland (16 Apr 1988).

The scattering of x-rays is the major source of background and hence is a limiting factor in the minimum detectable limits available with SRIXE measurements. The scattering can be utilized for normalizing the net peak areas to fluctuations in sample thickness or mass on a relative basis or on a comparative basis. Even then measurement of the scattered x-rays should be made at backward angles. Measurement at forward angles should be avoided because of diffraction problems. The uncertainties in the measurement of an absolute intensity of the x-rays can be extremely large.

37486 **(CONF-880364—28) Charge exchange stripping cell measurements over a wide pressure range.** Colchin, R.J.; Roquemore, A.L.; Scott, S.D. (Oak Ridge National Lab., TN (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). 1988. Contract AC05-84OR21400. 14p. (CONF-880364—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011016/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

The efficiency of the stripping cell incorporated in a charge exchange analyzer has been measured over a pressure range of 1.8 to 130 mtorr and over an energy range of 1 to 130 keV/amu. In these measurements, a beam of hydrogen atoms was ionized by helium gas. As a by-product of the measurements, the scattering cross section was also measured. At the lowest pressure, the scattering cross section compared well with those measured previously; at high pressure, the cross section no longer followed an energy power law. The analyzer efficiency (defined as the fraction of the atoms that is ionized and not lost through scattering) can be modeled over the entire range of energy and pressure by including the measured scattering cross sections.

37487 **(CONF-8708180—13) Experimental observation of diffraction patterns from micro-specimens.** Sayre, D.; Yun, W.B.; Kirz, J. (International Business Machines Corp., Yorktown Heights, NY (USA). Thomas J. Watson Research Center; Argonne National Lab., IL (USA); State Univ. of New York, Stony Brook (USA). Dept. of Physics). Mar 1988. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012049/JAW.

From Symposium on X-ray microscopy; Upton, NY, USA (31 Aug 1987).

Small non-periodic specimens scatter soft x-rays strongly enough to permit scattered-photon imaging. For the type of imaging principally studied here (diffraction-pattern imaging), the requirements on divergence and monochromaticity of the illumination are also moderately well understood, and appear to be capable of being sufficiently well met by undulator beamlines to permit imaging to the diffraction-limited resolution of $\lambda/2$, provided of course that a method of phasing the diffraction pattern is available. It may be remarked that for holography the illumination requirements, while varying with the form of holography, are more severe than for diffraction-pattern imaging, while for imaging microscopy they may be considerably less severe, depending on the angular and frequency bandwidths of the imaging element. It would appear to be for this reason that imaging microscopes are currently achieving exposure times of a few seconds even on bending-magnet beamlines.

37488 **(DOE/ER/40039—19) Gas delivery system and beamline studies for the test beam facility of the Collider Detector at Fermilab.** Franke, H.G. III. (Texas A and M Univ., College Station (USA). Dept. of Physics). Dec 1987. Contract AS05-81ER40039. 121p. NTIS, PC A06;3. Order Number DE88011178/JAW.

A fixed-target test beam facility has been designed and constructed at the Meson Test (MT) site to support studies of components of the Collider Detector at Fermi National Accelerator Laboratory (CDF). I assisted in the design and constuction of the test beam facility gas delivery system, and I conducted the initial studies to document the ability of the MT beamline to meet the needs of CDF. Analysis of the preliminary performance data on MT beamline components and beam tunes at required particle energies is presented. Preliminary studies show that the MT beamline has the necessary flexibility to satisfy most CDF requirements now.

37489 **(DOE/ER/40150—44) Application of radio frequency superconductivity to recirculating linacs.** Sundelin, R.M. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1988. Contract AC05-84ER40150. 17p. (CEBAF-PR—88-002). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008599/JAW.

Although an recirculating linear accelerator (RLA) was built and successfully operated many years ago, recent developments in rf superconductivity, which developments have raised practical gradients from 2 MV/m to 5 MV/m, have made RLA's with energies >1 GeV economically feasible. RLA's using present superconducting rf technology are slightly less expensive and have substantially higher quality beams than stretcher rings fed by pulsed linacs. This paper discusses these developments and new design considerations. 25 refs., 7 figs.

37490 **(DOE/ER/45231—3) [Construction and operation of SUNY facilities at the National Synchrotron Light Source]: Progress report, December 1, 1987-November 30, 1988.** Coppens, P. (State Univ. of New York, Buffalo (USA)). 1988. Contract FG02-86ER45231. 30p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010538/JAW.

The SUNY PRT was formed in 1980 to give SUNY researchers and their associates access to advanced facilities in Materials Research at the National Synchrotron Light Source. The beamline which we have constructed during the past years allows a large variety of novel experiments, and will achieve its full potential when NSLS resumes operation. It is open to all PRT members, which include non-SUNY faculty, and in addition provides access to general users during 25% of beamtime. The PRT has designed and constructed a multi-disciplinary facility, initially located at port X21, and more recently moved to X3. The first branch, X21A, became operational in January 1985 at the start-up of the x-ray ring. By the end of the Phase 1 experimental period, four ports were being used or in advanced states of commissioning. Modifications and additions are being made during the move to X3 which will result in five experimental stations, of which three will have independent optics, and two timeshare a mirror/monochromator combination. A description of the present status of the stations and a summary of recent results are given. Since no beamtime was

available during the past 14 months, these mainly reflect analysis of data collected in the preceding year. A full list of PRT publications since the inception of the project is included. The large number of papers presented at conferences during the 1986-1989 period attest to the productivity of our facility.

37491 **(FNAL-TM—1519) Rf cavity primer for cyclic proton accelerators.** Griffin, J.E. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1988. Contract AC02-76CH03000. 37p. (CONF-8705291—). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010655/JAW.

From 4. INFN ELOISATRON project workshop: very high energy proton-proton physics; Erice, Italy (31 May 1987).

The purpose of this note is to describe the electrical and mechanical properites of particle accelerator rf cavities in a manner which will be useful to physics and engineering graduates entering the accelerator field. The discussion will be limited to proton (or antiproton) synchrotron accelerators or storage rings operating roughly in the range of 20 to 200 MHz. The very high gradient, fixed frequency UHF or microwave devices appropriate for electron machines and the somewhat lower frequency and broader bandwidth devices required for heavy ion accelerators are discussed extensively in other papers in this series. While it is common pratice to employ field calculation programs such as SUPERFISH, URMEL, or MAFIA as design aids in the development of rf cavities, we attempt here to elucidate various of the design parameters commonly dealt with in proton machines through the use of simple standing wave coaxial resonator expressions. In so doing, we treat only standing wave structures. Although low-impedance, moderately broad pass-band travelling wave accelerating systems are used in the CERN SPS, such systems are more commonly found in linacs, and they have not been used widely in large cyclic accelerators. Two appendices providing useful supporting material regarding relativistic particle dynamics and synchrotron motion in cyclic accelerators are added to supplement the text.

37492 (GSI—87-11, pp D12.1-D12.2) **Beam port and irradiation chamber of the RIKEN ring cyclotron for biological samples.** Kaneko, I.; Eguchi-Kasai, K.; Takahashi, T.; Kosaka, T.; Nakano, K. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37493 (GSI—87-11, pp K6.1-K6.6) **Heavy ion synchrotron SIS.** Blasche, K. Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37494 (GSI—87-11, pp K7.1-K7.7) **Projectile-fragment separator at SIS.** Geissel, H.; Armbruster, P.; Franczak, B.; Klepper, O.; Langenbeck, B.; Nickel, F.; Poppensieker, K.; Roeckl, E.; Schardt, D.; Schmidt, K.H. Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37495 **(GSI—87-84-Prepr.) RF system of a synchrotron for protons and heavy ions.** Boehne, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Dec 1987. 15p. (CONF-8705288—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753378/JAW.

From 3. workshop on new techniques for future acceleration: RF and microwave systems; Erice, Italy (23 May 1987).

In this paper the potential and the constraints of producing many kilovolts of rf accelerating voltage for synchrotrons in a cumbersome board frequency range are reviewed from the electrical engineering standpoint. This paper elaborates on numbers and limits which determine cost and complexity of the rf system. (orig./HSI).

37496 **(INFN/TC—86-14) Construction and assembling of the trim coils for the Milan superconducting cyclotron.** Baccaglioni, G.; Cartegni, G.C.; Fusetti, M.; Gini, L.; Grilli, L. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1986. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702276/JAW.

This paper presents the main characteristics of the trim coils realized for the heavy ions superconducting cyclotron under construction at the Milan University. The guidelines in the choice of the conductor size, of the insulation and cooling parameters are discussed in some details. The main operations in the coils construction, as winding, impregnation, electrical tests and assembling, are described.

37497 **(INFN/TC—87-11) Optimization of the shape of the HV electrode of the electrostatic deflectors for the Milan superconducting cyclotron.** De Martinis, C.; Ferrari, A. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1987. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702277/JAW.

The electrostatic deflectors for the extraction of the beam from the Milan Superconducting Cyclotron are presently under development. The early tests showed that major troubles arise from the modifications induced in the discharge mechanism by the presence of the magnetic field, resulting in a drastic reduction of the deflector performances. Therefore a detailed analysis of the electric field configuration of the deflector has been carried out in order to improve its performances. In this paper the results so far obtained in the optimization of the shape of the electrode and insulator fixing are reported.

37498 **(INIS-SU—28) Non-mirror wave reflection by strip grating on the metal-dielectric substrates.** Kusajkin, A.P. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702389/JAW.

On the basis of the strong solution of the diffraction problem numerical investigation of energetic and phase characteristics of iron-mirror reflection of a plane wave from infinite periodic strip grating placed on the metallodielectric sublayer has been carried out. The results obtained are of interest for development of the systems of attenuation of interferences, creation of high quality open resonators, waveguide filters, diplexers and others SHF devices. Preprint-313; 10 refs.; 18 figs.

37499 **(JINR—9-87-322) Measurement of JINR modified phasotron extracted proton beam parameters.** Abazov, V.M.; Gustov, S.A.; Zorin, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702122/JAW.

The energy, energy distributions, vertical and horizontal emittances of extracted proton beam of modified JINR phasotron are measured. It is shown that the measured beam parameters permit to solve satisfactorily the problem of beam transport to the target of the π-meson wide angle lens. 8 refs.; 3 figs.; 1 tab.

37500 **(KEK—87-8) Proceedings of the 6th meeting on ultra high vacuum techniques for accelerators and storage rings.** Horikoshi, Gen-ichi (ed.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Aug 1987. vp. (In Japanese). (CONF-8702140—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780082/JAW.

From 6. meeting on ultra high vacuum techniques for accelerators and storage rings; Oho, Japan (27 Feb 1987).

Separate abstracts were prepared for individual papers in these proceedings. (LEW)

37501 **(LA-UR—88-1617) A CW-pion focusing horn for low-energy muon neutrino beams.** Dombeck, T.; Koetke, D.D.; Koetke, D.S.; Fisk, R. (Los Alamos National Lab., NM (USA); Valparaiso Univ., IN (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-880695—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010923/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

Low-energy muon neutrino beams can be produced from pion decays in-flight at high-intensity accelerators, such as the Los Alamos Meson Physics Facility (LAMPF), providing a new tool to study the role of the weak interaction in nuclear and particle physics. Employing a pion focusing device can enhance the neutrino flux by large factors, and reduce backgrounds by sign-selection of the parent pions. However, LAMPF's long beam pulse and high repetition rate makes it impractical to use pulsed horns like those found at high-energy accelerators. In this paper we discuss a CW-pion focusing device that uses coils wound inside vanes mounted radially around the beam axis to provide an azimuthal field. From our studies with a prototype magnet, we have found the optimum field configuration needed to focus pions at LAMPF energies can be obtained by adjusting the radial density of turns in the coils. This optimum yields an eight-fold increase in neutrino flux above the muon threshold over the bare-target case. Our calculations also indicate a correlation between the arrival time of the neutrinos in the detector and their energy.

37502 **(LA-UR—88-1687) Linac working group technical summary.** Schriber, S.O. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880263—5). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010934/JAW.

From Accelerator design workshop; Los Alamos, NM, USA (22 Feb 1988).

The working group looked at linac injectors for a Superconducting Super Collider (SSC) or Hadron Facility. Discussion includes rf power, a possible strawman linac, ion source/injector, radio-frequency quadrupole, and coupled-cavity linac. (LEW)

37503 **(LBL—24686) Development of high current and high brightness negative hydrogen ion sources.** Leung, K.N. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 21p. (CONF-880614—1; CONF-880614—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010882/JAW.

From 7. international conference on ion implantation technology; Kyoto, Japan (7 Jun 1988).

Negative hydrogen ions have found important applications in particle accelerators and in fusion research. These ions can be generated from two different types of ion sources—the surface conversion source and the volume production source. Recent experiments demonstrate that H/sup {minus/} current exceeding 1 A can be obtained from both types of ion sources. Because of the lower H/sup {minus/} ion temperature and the fact that they can be operated without cesium, volume H/sup {minus/} sources are highly desired. However, further technology must be developed on the control of electrons and the reduction of gas flow before this type of sources become practical units of a multiampere neutral beam injection system.

37504 **(LBL—24734) Advances in metal ion sources.** Brown, I.G. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 15p. (CONF-880614—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012020/JAW.

From 7. international conference on ion implantation technology; Kyoto, Japan (7 Jun 1988).

Beams of metallic ion species can be produced by the ECR (electron cyclotron resonance) ion source and by the MEVVA (metal vapor vacuum arc) ion source. Although the ECR source is fundamentally a gaseous ion source, metal ion beams can be produced by introducing metallic feed material into the plasma discharge using a number of techniques. The ion charge states can be very high, which is a significant advantage to most applications. The MEVVA ion source, on the other hand, is specifically a metal ion source. It has produced metallic ion beams from virtually all the solid metallic elements at a current of typically hundreds of milliamperes; the ions produced are in general multiply ionized, but not as highly stripped as those generated in the ECR source. Although the MEVVA source at present operates in a pulsed mode with a low duty cycle (≦ 1%), work is in progress to increase the duty cycle significantly. In this paper the operation and performance of the LBL ECR and MEVVA ion sources, with respect to metal ion generation, are described.

37506 **(LBL—25255) Insertion device vacuum system designs.** Hoyer, E. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 12p. (CONF-880552—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012025/JAW.

From Vacuum design of advanced and compact synchrotron light sources; Upton, NY, USA (16 May 1988).

Synchrotron light source insertion device vacuum systems now in operation and systems proposed for the future are reviewed. An overview of insertion devices is given and four generic vacuum chamber designs, transition section design and pumping considerations are discussed. Examples of vacuum chamber systems are presented.

37506 **(SAND—88-1032) RADLAC-II upgrade injector experiments.** Hasti, D.E.; Shope, S.L.; Frost, C.A.; Leifeste, G.T.; Mazarakis, M.G.; Poukey, J.W.; Smith, D.L. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011282/JAW.

The RADLAC-II upgrade is correcting pulsed power and beam injection and transport problems to increase the output beam energy and current and to improve beam quality. Initial experiments with a modified pulsed power module and injector are described and results, which agree with predictions, are presented. The pulsed power module generated >2.5 MVstage with >40 ns pulse width and >20 ns flattop. The output from the RADLAC-II injector, using two of these stages, was a 5 MeV, 40 kA, 1 cm radius annular beam with β/sub {perpendicular/} = 0.19. Particle code simulations show that the beam which the injector experiments produced will result in a 20 MeV, 40 kA, 1 cm radius beam with total β/sub {perpendicular/} < 0.2, when the upgrade is completed. This beam will allow high current conditioning, lead pulse stability, and current scaling experiments to be completed.

37507 **(SLAC-PUB—4622) Algorithms for the self-consistent simulation of high power klystrons.** Eppley, K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC03-76SF00515. 6p. (CONF-880178—5). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010684/JAW.

From Workshop on accelerator and beam optics codes; San Diego, CA, USA (19 Jan 1988).

We discuss an improvement to the algorithm developed by Yu for modelling rf cavities in klystrons using the port approximation. In this method, the cavity is simulated by imposing an rf voltage as a boundary condition across the outer wall. The voltage and phase are chosen to be consistent with the cavity impedence and with the rf current induced by the electron beam. In the original method, each cavity was calculated successively using either linear theory or an iterative method to achieve a self-consistent voltage. The new method relaxes the voltage and phase of several cavities simultaneously during the simulation. The time dependence of the voltages are calculated from a relaxation equation. The new algorithm reduces the total computation time by about a factor of five for a complete klystron.

37508 **(UCRL—21052) Preliminary design for a pierce wiggler beamstick and addendum.** Pirkle, D. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 30p. NTIS, PC A03;3. Order Number DE88011310/JAW.

Lawrence Livermore National Laboratory is developing a fast tunable microwave source for operation at 250 GHz and 10kW peak output power. This report presents the preliminary design of a Pierce gun and solenoid magnet that will be compatible with a Pierce-wiggler electron beam formation system (beamstick). The beamstick will be an appropriate power source for a tunable gyro-BWO at 250 GHz. Figure 1 presents the major components of the Pierce-wiggler beamstick: the electron gun, solenoid, beam tunnel, wiggler, and vacuum valve. Figure 2 shows an artistic conception of how the beamstick will interface with the interaction magnet, modulator and gyro-BWO circuit at MIT. 15 figs.

37509 **Progress report on the SLD Cerenkov ring imaging detector system.** Hallewell, G.; Ashford, V.; Bienz, T.; Bird, F.; Gaillard, M.; Kwon, Y.J.; Leith, D.; McShurley, D.; Nuttall, A.; Oxoby, G. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 398-403(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors report on the development of the Cerenkov Ring Imaging Detector for the SLD experiment at the SLAC Linear Collider. In particular the authors outline recent progress in engineering and new construction techniques which will greatly simplify the manufacture of the 40 quartz window drift tubes required for the barrel CRID. Progress in the preliminary design of the endcap CRID is reviewed, and the development of operating, monitoring and control systems for the complete detector is discussed.

37510 **The CEBAF control system architecture.** Bork, R. (Continuous Electron Beam Accelerator Facility, 12070 Jefferson Avenue, Newport News, VA 23606 (US)). pp 523-525 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The focus of this paper is on CEBAF's computer control system. This control system utilizes computers in a distributed, networked configuration. The architecture, networking and operating system of the computers and preliminary performance data are presented. The authors also discuss the design of the operator consoles and the interfacing between the computers and CEBAF's instrumentation and operating equipment.

37511 **Tuned beam position detector for the Fermilab switchyard.** Kerns, Q.; Childress, S.; Crawford, C.; Fuja, R.; Janes, R. pp 661-663 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Stripline beam position detectors, similar to those in the Fermilab Energy Doubler, have been designed to operate in the Fermilab Switchyard, with instantaneous extracted beam intensities smaller by a factor of 10^7 than present in the accelerator. The detectors are tuned to resonance at the RF frequency of 53.1 MHz., with a resulting increase of detector shunt impedance from 50 Ω to 9.5 KΩ and a Q of around 190. Beam position determination of 0.1 mm has been achieved for beam intensities as small as 10^3 protons per RF bucket.

37512 **Beam trajectory acquisition system for the arcs of the Stanford Linear Collider.** Pellegrin, J.L.; Ross, M.C.; Scott, B.D.; Wilson, D.S. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 673-675 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—). Contract AC03-76SF00515.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Beam Position Monitoring system of the Collider Arcs constitute the main tool, along with the Moving Magnet system and the Backleg Windings, for controlling the beam emittance growth. The two Arcs are analogous to two strongly focused transport lines. The focusing and defocusing magnets can be rocked an amount of +- 1 mm at their upstream end as part of the orbit correction scheme. This motion is in one plane only and, as a result, the BPM, which is mounted on the moving end of each magnet, is wired in such a way as to detect horizontal or vertical beam displacements only, depending on whether this BPM is attached to a focusing or a defocusing magnet. This Beam Position Monitoring system is different from other BPM systems at SLAC, not only by the expense of its hardware (908) monitors, 500,000 feet of coaxial cable, over 20,000 connectors) but also by its ungated, self-triggered electronics. Moreover, it is the first time that the authors attempt to operate their BPMs with all the processing electronics installed in the accelerator tunnel.

37513 **The Los Alamos Free-Electron Laser energy-recovery experiment.** Feldman, D.W.; Warren, R.W.; Watson, J.M.; Stein, W.E.; Fraser, J.S.; Spalek, G.; Lumpkin, A.H.; Carlsten, B.E.; Takeda, H.; Wang, T.F. (Los Alamos National Lab., Los Alamos, NM (US)). pp 221-223 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors concluded experiments demonstrating energy recovery in conjunction with the Los Alamos free-electron laser. In this paper, the authors discuss measurements of electron-beam transport during decelerations greater than 70% from 21 MeV down to 5 MeV. Power-flow measurements demonstrate the efficient conversion of beam power back into rf power and it reuse in the accelerator. They also describe instabilities of the system and compare them with simulations.

37514 **State of the art in polarized proton sources.** Alessi, J.G. (Brookhaven National Lab., Upton, NY (US)). pp 249-253 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Present day polarized H/sup +/ and H/sup -/ ion sources are reviewed by describing the performance of sources representative of each of the techniques being used. New ideas for producing higher intensities are then mentioned. Presently, pulsed H/sup +/ currents in the milliampere range, and H/sup -/ currents of hundreds of μA's, can be obtained.

37515 **Commissioning of the SLC injector.** Sheppard, J.C.; Bambade, P.S.; Clendenin, J.E.; Gearhart, R.A.; Miller, R.H.; Sodja, J. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 43-46 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

For every cycle of the SLC, the injector is required to launch two electron bunches and a single positron bunch into their respective emittance damping rings. Each bunch is to have a population of 7.5x10/sup 10/ particles/bunch, an energy of 1.21 GeV, and a full width energy spread of less than 2%. The electron beams are produced from a thermionic cathode, bunched, and accelerated to about 200 MeV. Positrons are injected after electrons at the 200 MeV point. The three bunches, spaced by approximately 60 ns, are subsequently accelerated to the damping ring energy within a single RF pulse. As of September 1986, all of the injector hardware had been installed and tested. Single electron bunches were being produced, stabilized with respect to energy characteristics, and injected into the damping rings. Commissioning of two electron bunch operation is currently in progress. Three bunch running should be commissioned by early 1987 and the SLC injector is expected to be operational by April 1987. This paper reports on the hardware and software developments necessary for the injector. The operational status of the entire system is discussed.

37516 **Motion control system for the Fermilab electrostatic septa.** Lackey, S.; Coburn, M.; Crawford, C.; Elseth, J.; Knopf, W. (Fermi National Accelerator Lab. (US)). pp 617-618 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

For many years the intensities of the proton beams going to the various experimental areas of the Fermi National Accelerator Laboratory were controlled by moving the beam relative to the wires of the electrostatic septa splitting stations. A change in this basic philosophy was made previous to the last fixed target run at Fermilab. The authors now have a system that moves the septa relative to the stationary beam. Magnets are no longer adjusted while changing split ratios. This has resulted in less tuning of the beam lines downstream of splitting stations. As many as ten, ten foot long electrostatic septa have been moved simultaneously while maintaining alignment to within a mil.

37517 **New low-level RF system for the Fermilab booster synchrotron.** Kerns, C.; Crisp, J.; Kerns, Q.; Miller, H. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 619-621 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper describes the Booster low-level RF system that was constructed to meet these recently added requirements: (1) synthesizer controlled capture frequency at injection, (2) very low-phase noise over the machine cycle, (3) smooth phase-lock of beam to an external reference frequency and (4) ability to accelerate either a full turn or partial turn of beam.

37518 **Resonance control for a CW accelerator.** Young, L.M.; Biddle, R.S. (Los Alamos National Lab., Los Alamos, NM (US)). pp 634-636 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper describes a resonance-control technique that has been successfully applied to several cw accelerating structures built by the Los Alamos National Laboratory for the National Bureau of Standards and for the University of Illinois. The technique involves sensing the rf fields in an accelerating structure as well as the rf power feeding into the cavity and, then, using the measurement to control the resonant frequency of the structure by altering the temperature of the structure. The temperature of the structure is altered by adjusting the temperature of the circulating cooling water. The technique has been applied to continuous wave (cw) side-coupled cavities only but should have applications with most high-average-power accelerator structures. Some additional effort would be required for pulsed systems.

37519 **Progress in the design of a DC FEL power source using a pelletron driver.** Larson, D.J.; Cline, D.B.; Anderson, D.R.; Rosenzweig, J.B.; Mills, F.E.; Sundquist, M.L.; Adney, J.R.; Dehais, S.J. (Univ. of Wisconsin, 1150 University Ave., Madison, WI (US)). pp 215-217 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors discuss progress in the design of a DC Free Electron Laser power source using a Pelletron electrostatic accelerator as a driver. Such a power source should deliver up to 200 kW DC power in wavelengths ranging from a few microns to a few centimeters. The advantages of this system for use as a power source for future acceleration techniques are its efficiency, tunability and high average power. In order to achieve DC operation of the system extremely high electron recovery efficiencies are required. It is also likely that FEL operation will result in a large spread of electron energies. These design constraints require the development of a highly efficient electron beam collector as well as beam optic capable of recirculating beams with a large energy spread. The authors present collector and beamline designs and include electron optics studies for the full range of operating conditions.

37520 **On-line electron beam measurements for the Los Alamos Free-Electron Laser.** Lumpkin, A.H.; Feldman, R.B.; Feldman, D.W.; Stein, W.E. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM (US)). pp 212-214 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Recent developments in the electron beam diagnostics used on the Los Alamos Free-Electron Laser (FEL) have extended the authors' on-line, quantitative analysis capability to extraction efficiency and micropulse temporal duration. The FEL's 20-MeV electron beam is 10 μs in length and consists of —2000 micropulses of 20-ps duration and 46-ns separation. This extreme range of time scales is addressed by employing a combination of synchronized beam deflectors, an electron spectrometer, intensified video cameras, real-time video digitizers, and microcomputers. The tapered wiggler result for extraction efficiency (2%)and results for pulse duration measurements (10-15 ps) by two techniques are presented.

37521 **A single-pass free-electron laser for soft x-rays with wavelengths $\leqq$ 10 nm.** Goldstein, J.C.; Wang, T.F.; Newnam, B.E.; McVey, B.D. (Los Alamos National Lab., Los Alamos, NM (US)). pp 202-204 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors consider a single-pass FEL amplifier, driven by an rf-linac followed by a damping ring for reduced emittance, for use in generating intense coherent light at wavelengths $<$ 10 nm. The dependence of the optical gain on electron beam quality, studied with the 3-D FEL simulation code FELEX, is given and related to the expected power of self-amplified spontaneous emission. Design issues for the damping ring to achieve the required electron beam quality are discussed.

37522 **Plasma wave wigglers for free electron lasers.** Joshi, C.; Katsouleas, T.; Dawson, J.M.; Yan, Y.T.; Chen, F.F. (Univ. of California, Los Angeles, CA (US)). pp 199-201 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors explore the possibility of using relativistic plasma density waves as wigglers for producing free electron laser radiation. Two possible wave and beam geometries are explored. In the first, the wiggler is a purely electric wiggler with frequency ω/sub p/ (plasma frequency) but (approximately) zero wavenumber κ/sub p/. If an electron beam is injected parallel to a wide plasma wave wavefront, it is wiggled transversely with an apparent wiggler wavelength λ/sub w/ = $2\pi c/\omega$/sub p/. In the second scheme, the electron beam is injected down the axis between two narrow plasma waves propagating opposite to the beam. The electrons are wiggled by the radial fields of the waves and are guided (focused) by the waves' ponderomotive force. With either scheme, effective wiggler wavelengths of order 50-100 μ may be obtained in a plasma of density 10/sup 17/(cm/sup -3/), thereby permitting generation of short wavelength radiation with modest energy beams. The effective wiggler strengths a/sub w/ = eA/mc/sup 2/ $\approx$ 0.5 can extremely large. The authors discuss the excitation methods for such wigglers and examine these with PIC computer simulations.

37523 **Induction linac-based FELs.** Briggs, R.J.; Birx, D.L.; Prono, D.S.; Prosnitz, D.; Reginato, L.L. (Lawrence Livermore National Lab., Livermore, CA (US)). pp 178-182 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The multikiloampere peak currents available from linear induction accelerators make high-gain, free-electron-laser-amplifier configurations feasible. High-extraction efficiencies in a single pass of the electron beam are possible if the wiggler parameters are appropriately "tapered," as recently demonstrated at millimeter wavelengths on the 4-MeV ELF facility. Magnetic pulse power systems enable high-repetition-rate operation of the accelerator for high-average-power applications. Key issues involved in extending the technology to shorter wavelengths and higher average power are described.

37524 **Superconducting quadrupoles for the SLC final focus.** Erickson, R.; Fieguth, T.; Murray, J.J. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 142-144 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The final focus system of the SLC will be upgraded by replacing the final quadrupoles with higher gradient supperconducting magnets positioned closer to the interaction point. The parameters of the new system have been chosen to be compatible with the experimental detectors with a minimum of changes to other final focus components. These parameter choices are discussed along with the expected improvement in SLC performance.

37525 **Collective ion acceleration via laser controlled ionization channel.** Destler, W.W.; O'Shea, P.G.; Rodgers, J.; Segalov, Z. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD (US)). pp 103-105 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Initial results from a successful laser-controlled collective ion acceleration experiment at the University of Maryland are presented. In the experiment, positive ions are trapped in the potential well at the head of an intense relativistic electron beam injected at current levels above the space charge limit. Seed ions for acceleration are provided by puff valve injection of a neutral gas cloud localized to within 3 cm of the injection point. Control over the acceleration of the well and the ions is then achieved by means of a laser-generated ionization channel produced by passing the light from a Q-switched ruby laser through a series of partially and fully reflecting mirrors in such a way as to provide time-sequenced laser ionization of a target located on the drift tube wall. Using this system, controlled acceleration of protons at a rate of approximately 40 MV/m has been demonstrated over a distance of about 50 cm.

37526 **Fabrication and 35GH/sub z/ testing of key two-beam accelerator components.** Hopkins, D.B.; Koehler, G.W.; Kuenning, R.W.; Low, W.; Sessler, A.M.; Prosnitz, D.; Throop, A.L.; Westenskow, G.R.; Haimson, J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 80-82 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper discusses two 34-cavity 10-cm long, 33.3 GH/sub z/ high gradient accelerator sections fabricated by different methods. Also described are the construction and testing of a septum coupler designed for periodically extracting power from the free electron laser (FEL) portion of a two-beam accelerator.

37527 **A design for a 2 km experimental straight section for the SSC.** Johnson, D.E.; Toohig, T.E. (SSC Central Design Group, c/o Lawrence Berkeley Lab., Berkeley, CA (US)). pp 89-90 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The design of an experimental insertion for the SSC suitable for a very forward spectrometer is presented. This design has a usable space of +-1000 m around the interaction point and can achieve a luminosity of approximately 10/sup 30/ cm/sup -2/ s/sup -1/. The design utilizes large-aperture quadrupoles which are part of the spectrometer array to focus the two beams. In order to achieve the necessary free space for this design, a beam bypass of one of the clustered straight sections is utilized. This bypass allows for the possibility of two, approximately 2.5 km sections free of horizontal dipole magnets. The bypass stubs needed to permit this possibility to be implemented in the future would increase the overall circumference of the SSC by roughly 3%.

4304 Storage Rings

REFER ALSO TO CITATION(S) 37476, 37477, 37500, 38431

37528 **(CONF-880552—3) Design for ANL 7 GeV storage ring vacuum system.** Wehrle, R.B.; Nielsen, R.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012064/JAW.

From Vacuum design of advanced and compact synchrotron light sources; Upton, NY, USA (16 May 1988).

The 7-GeV Advanced Photon Source (APS) design includes a storage ring having a 1060-m circumference with the capability of accommodating 34 insertion devices (ID) and their associated photon beam lines. An additional 35 photon lines can be provided from bending magnets. The vacuum system for the storage ring is designed to maintain a beam-on operating pressure of 1n Torr or less to achieve a positron beam lifetime of approximately 20 hours. The vacuum system and it's current developmental status are described.

37529 **(DESY-HERA—87-15) Modified harmonic closed orbit adjustment formalism for the optimization of polarization in electron storage rings.** Barber, D.P.; Ripken, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1987. 32p. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.).

We extend the closed orbit correction formalism of an earlier paper (1985) to take into account the notion that the polarization in electron storage rings may be more sensitive to tilts, δn vector, of the equilibrium spin axis in some parts of the lattice than in others. This is achieved by means of a periodic weighting function. The formalism requires some modifications of the computer program already developed for implementing the ideas given in the cited paper. (orig./HSI).

37530 **(GAO/RCED—87-175FS) Federal research projects: Concerns about DOE's super collider site selection process.** (General Accounting Office, Washington, DC (USA)). 1987. 23p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

In April 1987, the Department of Energy issued an invitation for site proposals for its proposed $4.375 billion Superconducting Super Collider soliciting states and others to provide land to the U.S. government on or under which to build and operate the SSC. This report examines whether precedents exist for selecting sites for multimillion dollar research projects on the basis of competitive bidding, with states providing land and other incentives.

37531 (INIS-mf—11223, pp 589-605) **Physics at the ep-collider HERA.** Mattig, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The basic features of the electron-proton storage ring HERA are presented and some possibilities of e-p measurements related to standard physics which offer HERA are discussed. The signatures and mass range of new states to be probed at HERA are also discussed. 20 refs., 15 figs. (M.F.W.).

37532 **(LA-UR—1682) Analysis ob beam losses at PSR [Proton Storage Ring].** Macek, R.J.; Fitzgerald, D.H.; Hutson, R.L.; Plum, M.A.; Thiessen, H.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 4p. (CONF-880695—2; CONF-880695—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010921/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

Beam losses and the resulting component activation at the Los Alamos Proton Storage Ring (PSR) have limited operating currents to about 30μA average at a repetition rate of 15 Hz. Loss rates were found to be approximately proportional to the circulating current and can be understood by a detailed accounting of emittance growth in the two step injection process along with Coulomb scattering of the stored beam during multiple traversals of the injection foil. Calculations and simulations of the losses are in reasonable agreement with measurements.

37533 **Relativistic heavy ion collider project: A status report.** Ludlam, T.W.; Samios, N.P. (Brookhaven National Lab., Upton, NY (USA)). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **38**: No. 1/2, 353-359(Apr 1988). (CONF-8708166—).

From 6. international conference on ultra-relativistic nucleus-nucleus collisions; Nordkirchen, F.R. Germany (24 Aug 1987).

The relativistic heavy ion collider (RHIC) is a proposed facility at Brookhaven National Laboratory for very high energy collisions of nuclear beams. The project has had a substantial amount of R and D effort and is ready to begin construction within the next year or two, as funding permits. We describe the parameters of the machine, discuss the current status of development work on the project, and describe the requirements for experiments at such a facility.

37534 **Operating results for the beam profile monitor system currently in use at Bevalac facility.** Stover, G.; Fowler, K. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 622-624 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Three stations of a soon to be completed multi-station, multi-wire beam monitoring system have been installed in the Bevalac transfer line. The following article provides a cursory analysis of the electronic circuitry, discuss new design additions and summarizes the operating results obtained the last year.

37535 **Nonlinear dynamics aspects of modern storage rings.** Helleman, R.H.G.; Kheifets, S.A. (La Jolla Institute, CNLS, P.O. Box 1434, La Jolla, CA 92038 (US)). pp 64-76 of Nonlinear dynamics aspects of particle accelerators. Araki, H.; Ehlers, J.; Hepp, K.; Kippenhahn, R.; Weidenmuller, A.; Zittartz, J. New York, NY; Springer-Verlag New York Inc. (1986). (CONF-850114—).

From Joint US/CERN School on Particle Accelerators topical course on non-linear dynamics; Sardinia, Italy (31 Jan 1985).

The authors try to address the following two questions: a. Why should accelerator physicists to be interested in the recent, sometimes abstract, developments in Nonlinear Dynamics, a field which will recently was mainly studied by mathematicians, theoretical physicists and astronomers? That such an interest to some extent already exists is apparent from the fact that many accelerator physicists attended this School and several analogous meetings in the past. b. Why should researchers from nonlinear dynamics be interested in modern Storage Rings which are largely designed and built by experimental physicists and engineers? At the moment few 'nonlinear scientists' work on storage rings (or in the field of accelerator physics). It is a hopeful sign that many (more) attended this School.

37536 **Theories of statistical equilibrium in electron-positron colliding-beam storage rings.** Schonfeld, J.F. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 315-342 of Nonlinear dynamics aspects of particle accelerators. Araki, H.; Ehlers, J.; Hepp, K.; Kippenhahn, R.; Weidenmuller, A.; Zittartz, J. New York, NY; Springer-Verlag New York Inc. (1986). (CONF-850114—).

From Joint US/CERN School on Particle Accelerators topical course on non-linear dynamics; Sardinia, Italy (31 Jan 1985).

In this lecture the author introduces some recent theoretical work that represents a significant and long overdue departure from the mainstream of ideas on the physics of colliding-beam storage rings. The goal of this work in question is to understand analytically - without recourse to computer simulation - the role that dissipation and noise play in the observed colliding-beam behavior of electron-positron storage rings. More traditional approaches have given such "thermal" processes relatively little attention, with results that have been qualitative at best.

37537 **(BNL-tr—1066) Metal-coated ceramic chambers for PETRA.** Hemmie, G. (Brookhaven National Lab., Upton, NY (USA)). [1988]. Contract AC02-76CH00016. Translation of report DESY--S1-77/05, May 1977. 33p. NTIS, PC A03;3.

The PETRA vacuum chamber should have as good a conductance as possible. The spectra of fields to which the chamber is to be transparent is relatively narrow, and beam instabilities are not expected until shunt impedence reach above 100Mhz, so metal coated ceramic chambers are to be used. Topics discussed include beam spectrum and beam measurements, losses in the chamber wall caused by the beam, shielding effect of a cylindrical metal coating, and measurement of homogeneity and losses. (LEW)

44 INSTRUMENTATION

37538 **(INPE—4124) 4-channel time delayed pulse generator.** Wetzel, L.F.S.; Rossi, J.O.; Del Bosco, E. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Feb 1987. 31p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702394/JAW.

It is described the project of a 4-channel delayed pulse generator employed to trigger the plasma centrifuge experiment of the Laboratorio Associado de Plasmas. The circuit delivers pulses with amplitude of 15V, full width at half maximum of 50μs and rise time of 0.7μs. The maximum time delay is 100ms. There are two channels with a fine adjustment of 0-1ms. The system can be manually or automatically driven.

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 35886, 36825, 36842, 36947, 37499, 37509, 37835, 37918, 38216, 38654, 38804, 38992, 39010, 39011, 39012, 39013

37539 **(BMU—1987-153) Use and adaptation of a process of aero-geophysics for special tasks of radiation protection. Final report.** Lenz, H.; Sengpiel, K.P. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). 1987. 70p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen,, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The problem was to apply a radiometric measuring system (with a detector crystal with a volume of 16.8 litres) which is part of the equipment of a BGR helicopter used for geophysical prospecting, for certain purposes of radiation protection. An extension of the existing EDP, the computer-controlled representation of results and of theoretical investigations was associated with this. Due to a larger flying program, documents on the natural radiation intensity in the Harz area and cover certain industrial, mining and waste disposal areas were produced. It is shown how the counting rates measured with the gamma ray spectrometer at altitude can be converted to equivalent dose rate of the radiation at ground level (for radiation sources distributed over large areas) by various corrections and conversions. The conditions in which a radioactive point source on the radiating earth's surface is traced by measurements in flight, are examined. A 256 channel analyser was used.

37540 **(BNL—41071) Aging effects in wire chambers operated at low pressure with TMAE and its effect on the use of BaF_2-TMAE calorimetry at the SSC [Superconducting Super Collider].** Woody, C.L. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-880356—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008773/JAW.

From Task force meeting on radiation effects at the superconducting super collider; Berkeley, CA, USA (7 Mar 1988).

This note summarizes the result of a study carried out on the aging effects in low pressure wire multiwire proportional chambers operated with gas mixtures containing TMAE. The purpose of the study was to investigate the effects of radiation damage in low pressure wire chambers used as a part of a BaF_2-TMAE calorimeter operated at high rates for an extended period of time. 8 refs., 6 figs.

37541 **(BNL—41078) Effects of radiation damage to TMP [tetramethylpentane], TMS [tetramethylsilane] and liquid argon solutions.** Holroyd, R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 14p. (CONF-880356—2). NTIS, PC A03. Order Number DE88008239/JAW.

From Task force meeting on radiation effects at the superconducting super collider; Berkeley, CA, USA (7 Mar 1988).

The effects of exposure of calorimeter liquids like tetramethylsilane (TMS), 2,2,4,4-tetramethylpentane (TMP) and liquid argon solutions to the large doses of ionizing radiation expected in the SCC environment is examined. Like other organic liquids TMS and TMP are decomposed by radiation to various products; thus, we must consider the effects these products may have on the calorimeter operation. Questions considered include how will radiation effect electron drift velocity and lifetime? Will gaseous products produce significant pressure buildup? Are dose rate effects significant? Do we expect different effects from neutrons compared to minimum ionizing radiation? 16 refs., 5 figs., 3 tabs.

37542 **(CENBG—8715) Monte-Carlo simulation of multicounter system characteristics used for the double beta decay study of ^{76}Ge.** Larrieu, P. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Oct 1987. 140p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753940/JAW.

The response function of a detection system including 19 NaI detectors in coincidence with 4 germanium detectors is a complex function of several parameters like nature and position of gamma rays emitting source, detector sizes, nature of constituent materials, system geometry. The most important characteristics of an experimental setup applied to the study of double beta decay in ^{76}Ge have been simulated using Monte Carlo calculations and compared to experimental results.

37543 **(CIEMAT—606) High speed UNIBUS-VME interface.** Olmos, P. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). Jun 1987. 50p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702839/JAW.

An interface between VME and the UNIBUS of PDP or VAX computer is presented. The system supports high speed parallel communication (up to 1MB/S) and is composed of two modules. One of these is a commercial DR11M board which performs DMA transfers between UNIBUS and the external word. The other is a VME module specifically developed for this application. The interface has been tested under VMS operating system in VAX and VALET-PLUS system for the VME Bus. We describe in detail the VME module and its connection with the DR11M. Software, both in WMS and VALET, is also described. (author) 10 figs., 7 refs.

37544 **(CONF-880546—13) Responses of C_6D_6 and C_6F_6 gamma-ray detectors and the capture in the 1.15-keV resonance of ^{56}Fe.** Perey, F.G.; Johnson, J.O.; Gabriel, T.A.; Macklin, R.L.; Winters, R.R.; Todd, J.H.; Hill, N.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. (CONF-880546—). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011008/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

We have used the electron gamma-ray transport code EGS to calculate responses of C_6D_6 and C_6F_6 gamma-ray detectors, where the geometry of the capture experiments was carefully modelled. Very good agreement was obtained with spectra from selected resonances in the capture of neutrons by ^{207}Pb. Weighting functions based upon the calculated responses were used in measuring the capture in the 1.15-keV resonance of ^{56}Fe relative to the capture in the Au 4.9-eV resonance. The neutron width was measured to be 64.5+-3. MeV with C_6F_6 detectors, and 63.0+-2.5 meV with C_6D_6 detectors. These valuues are in good agreement with the value of 61.7+-0.9 MeV found from transmission measurements. 16 refs., 6 figs.

37545 **(DOE/ER—13065-528) Performance of the AMY central drift chamber in a high magnetic field.** Ueno, Koji. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). [1988]. Contract AC02-76ER13065. 20p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008097/JAW.

This note describes the design characteristics of the AMY central drift changer (CDC) and its performance during its operation for the first year since it was installed in the AMY solenoid on October 24, 1986. In general, the chamber has performed according to our original specifications, providing us with good efficiency and excellent spatial resolution. 5 figs.

37546 **(DOE/ER/40039—20) Testing and calibrating a hadron calorimeter.** Cao, Hung Duc. (Texas A and M Univ., College Station (USA). Dept. of Physics). 1988. Contract AS05-81ER40039. 41p. NTIS, PC A03;3. Order Number DE88011177/JAW.

We propose to test and calibrate the Forward/Backward Hadron Calorimeter of the CDF (Collider Detector at Fermilab). It is designed to cover a pseudorapidity region of 2.2 ≤ {vert bar} {eta} {vert bar} ≤ 4.2. It is composed of multiproportional wire-chambers and steel plates. The test data were taken form the CDF Test Beam facility during Dec. 1987 and Jan. 1988. We describe the characteristics of our calorimeter and the result of our analysis. 8 refs., 17 figs.

37547 **(DOE/ER/40125—16) Indiana University high energy physics group, Task E. Technical progress report, December 1, 1987-June 1, 1988.** Alyea, E.D. Jr. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1988. Contract AC02-84ER40125. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012122/JAW.

Task E of the Indiana University High Energy Physics Group was established on December 1, 1987. This progress report covers the period December 1, 1987 to June 1, 1988. Work was concentrated on the development of the Large Volume Detector (LVD) at the Gran Sasso Laboratory in Italy. Most effort was devoted to design and experimental tests for the gas recirculating and purification system of the limited streamer tubes used in particle tracking. Some time was also devoted to the valuation of competing designs for the data acquisition system of the limited streamer tubes.

37548 **(DOE/ER/40325—2-A) Silicon drift-chamber prototype for the upgrade of the UA6 experiment at the CERN p {bar char}p collider.** Gatti, E.; Longoni, A.; Sampietro, M.; Giacomelli, P.; Vacchi, A.; Rehak, P.; Kemmer, J.; Holl, P.; Struder, L.; Kubischta, W. (Politecnico di Milano (Italy). Dipt. di Elettronica; Rockefeller Univ., New York (USA); Brookhaven National Lab., Upton, NY (USA); Technische Univ. Muencheń, Garching (Germany, F.R.). Fakultaet fuer Physik; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.); European Organization for Nuclear Research, Geneva (Switzerland)). 1987. Contract AC02-87ER40325. 10p. (CONF-8709153—4; RU—87/E-3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008099/JAW.

From Conference on position-sensitive detectors; London, UK (7 Sep 1987).

A large-area (≃ 4 x 4 cm^2) silicon drift chamber has been designed and constructed in order to investigate its possible use in the UA6 experiment. The drift chamber will supply unambiguously (x,y) space points on each track; each arm of the UA6 spectrometer will be provided with two layers of drift detectors. 12 refs., 4 figs.

37549 (GSI—87-11, pp A2.1-A2.4) **Profiles of latent tracks.** Albrecht, D. (Hartmann und Braun A.G. Mess- und Regeltechnik, Frankfurt am Main (Germany, F.R.)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37550 **(IKDA—87/12) Fast decay components in the scintillation gases Ar, Ar-N_2, Xe, and He-Xe excited by heavy-ion impact.** Grimm, P.; Hambsch, F.J.; Mutterer, M.; Theobald, J.P.; Kubota, S. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik; Rikkyo Univ., Tokyo (Japan). Dept. of Physics). May 1987. 17p. Also published in Nucl. Instrum. Methods Phys. Res., Sect. A (15 Dec 1987) Vol. 2162(2/3) p. 394-402.

The delayed single-photon method was applied to measure the decay-time structure of gas scintillations in the noble gases Ar and Xe, Ar with an admixture of N_2, and He with an admixture of Xe, after excitation by heavy ions. Measured decay times are fitted to relevant models that describe the population and decay of noble gas excimers as well as energy transfer processes. Deduced decay parameters are compared with values known from scintillations excited by lower-ionizing radiation. With 13 figs..

37551 **(INFN/AE—87-5) Charge collection in partially depleted Silicon detectors.** Fontanelli, F.; Ramella, P.; Vitale, S. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702274/JAW.

The behaviour of partially depleted silicon detectors deserves some attention in the design of large system as electromagnetic or hadronic calorimeters in which these detectors are used and conservative operating conditions must be imposed. Charge collection from the undepleted region in silicon detectors manufactured for high energy calorimetry by Ansaldo Semiconductors S.p.A. has been experimentally investigated. The observed results are compared with a simple model.

37552 **(INFN/TC—88-6) Pulse generator for the performance control of NAI detectors.** Castoldi, M.; Rottura, A. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 4p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702281/JAW.

A simple pulse generator is described that reveals to be economic and easy to be operated. The doublet generator can be assembled as a multistage version, due to its modular nature. The long term stability is also reported.

37553 **(ISH—110) Measurement of chemiluminescence of solids as possible indicator system for rapid dose determination following radiation accidents.** Hammermaier, A.; Reich, E.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jun 1987. 123p. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

14 different types of pharmaceutical tablets, 18 different pharmaceutical powders, and 32 other solid substances (foodstuffs, environmental materials, etc.) were tested. The results from pharmaceutical powders have shown after optimizing the test conditions that, in some pharmaceuticals, radiation doses of less than 1 Gy were still detectable. Other pharmaceuticals either demonstrated only a slight increase in intensity or none at all. For pharmaceuticals in tablet form, the sample must be processed prior to measurement (deteriorating the detection limit). For examining the various solid substances, materials were selected which are non-soluble or only poorly soluble in luminol solution. All samples were exposed to a radiation dose of 100 Gy. When extrapolating on the basis of a linear dose-effect relation-ship into a lower dose range, it becomes clear that it will be very difficult, if it is possible at all, to find any poorly soluble materials in the liminol solution which could indicate an exposure in the area of 10 Gy or below.

37554 **(ITEF—106(1987)) Installation for purification of liquid rare gases with volume to 100l by means of the spark technique.** Anisimov, S.N.; Barabash, A.S.; Bolozdynya, A.I.; Stekhanov, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702887/JAW.

An installation for purification of liquid rare gases with volume up to 100 l by means of a titanium powder sputtered into liquids by spark discharge has been constructed. In this installation 5 and 25 liquid krypton have been purified up to the electron capture length L=24 and 3 cm, respectively, in electric field E=2 kVcm at the temperature 135 K. Moreover it has been shown that a gaseous krypton are purified with help of the "nickel on kizilgure" ($NiSiO_3$) absorber from electronegative impurities. In this way in 5 of liquid krypton the electron capture length 3 cm (E=2 kVcm) have been achieved. 9 refs.; 7 figs.

37555 **(JINR—E-10-87-378) Supercomputer for parallel data analysis.** Kolpakov, I.F.; Senner, A.E.; Smirnov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702148/JAW.

The project of a powerful multiprocessor system is proposed. The main purpose of the project is to develop a low cost computer system with a processing rate of a few tens of millions of operations per second. The system solves many problems of data analysis from high-energy physics spectrometers. It includes about 70 MOTOROLA-68020 based powerful slave microprocessor boards liaisoned through the VME crates to a host VAX micro computer. Each single microprocessor board performs the same algorithm requiring large computing time. The host computer distributes data over the microprocessor board, collects and combines obtained results. The architecture of the system easily allows one to use it in the real time mode. 4 refs.; 6 figs.

37556 **(JINR—R-1-87-560) Software and hardware complex on the base of semiconductor detectors operating on-line with the MERA-60/45, ES-1060 and ES-1061 computers.** Butsev, V.S.; Butseva, G.L.; Nefed'eva, L.S.; Panyutchev, E.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702159/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The improved software and hardware complex (setup GAMMA) are described in detail. Using these facilities, the fragmentation of projectiles, target-nuclei and production and decay mechanism of radioactive nuclides on beams of relativistic particles and nuclei (p, d, a, ^{12}C, ^{16}O) of an energy of 4.5 GeVnucleon ac-

celerated at the Dubna synchrophasotron have been studied during 1980-1987. The facilities consist of Ge(Li)-detectors CAMAC multichannel analyzers on-line with HP-2116B and MERA-6045 computers and appropriate software. The facilities are used for the acquisition of spectrometric information, its preliminary processing and transfer to the base BESM-6, ES-1060 and ES-1061 computers. A problem-oriented system of programs for precision spectrometric information processing used in the indicated experiments is described. 17 refs.; 5 figs.

37557 **(JINR—R-3-87-531) Resolution function of neutron diffractometer on IBR-2 pulsed reactor.** Balagurov, A.M.; Beskrovnyj, A.I.; Popa, N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702449/JAW.

The resolution of the time-of-flight neutron diffractometer DN-2 on the IBR-2 is constructed on the base of experimental data. The comparison of calculated and measured diffraction spectra from the standard Al_2O_3 polycrystalline sample pointed to their conformity within the 2.5% limit. 4 refs.; 9 figs.; 1 tab.

37558 **(JINR-E—13-87-399) High-voltage test and training of plastic streamer tubes for the DELPHI hadron calorimeter.** Alekseev, G.D.; Cellar, S.; Khomenko, B.A.; Korytov, A.V.; Kulinich, P.A.; Micelmacher, G.V.; Sedykh, Yu.V.; Toledo, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702915/JAW.

Submitted to the journal DELPHI-Notes.

The results of high-voltage test and training of plastic streamer tubes of the DELPHI hadron calorimeter are presented. The testing technique is considered in detail. The equipment for high-voltage training consists of a mini-computer, CAMAC-electronics, a controllable high-voltage supply and a digital ampermeter. The experimental results shows that high-voltage training of streamer tubes improves their characteristics. The value of dark current decreased up to 1 μA. The operational voltage range increased by a value more than 300 V. 2 refs.; 8 figs.

37559 **(JINR-R—1-87-551) Electron and hadron separation by means of a system consisting of an active converters, scintillation counter and total absorption spectrometer.** Astvatsaturov, R.G.; Arkhipov, V.V.; Vasil'ev, S.E. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702925/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The possibility of hadron suppression with the aid of the system consisting of an "active" lead-glass converter, Cherenkov lead-glass γ-spectrometer and a scintillation counter of 1 m long was investigated on a beam of 2 GeVc π^--mesons that contains ~6% of electrons. The scintillation counter having two photomultipliers at two opposite ends operated in the dEdx mode. The application of the system of counters makes it possible to increase the hadron suppression by a factor of 14 as compared to the one by total absorption counters only. The detection efficiency of electron is > 90%. The accuracy of determination of the axis X-coordinate σ/sub x/ of an electromagnetic shower produced in converters (lead glass, lead plates) was also investigated by means of the scintillation counter by the time interval between the arrival of light signals. The accuracy of measuring the axis X-coordinate of the electromagnetic shower in the lead plates from 2 r.u. to 6 r.u. in thickness was practically constant (σ/sub x/=2.1 cm). 7 refs.; 6 figs.; 1 tab.

37560 **(JINR-R—10-87-254) Specialized processor with algebraic structure for event fast selection.** Nikityuk, N.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702937/JAW.

Submitted to the journal Instrum. Exp. Tech. .

A processor having algebraic structure for fast selection of events detected in a scintillation hodoscope is described. The main property of the processor is that data read out from the scintillation hodoscope and then (in parallel) analysed to determine the multiplicity of events and their coordinates are calculated. The rule for the construction of such a processor is the following. The number of inputs n is 15, signals t=1, t=2, t=3 and t ≧ 4 are formed from the first group of outputs, information on the coordinates of three simultaneously registered events is obtained from the second group of outputs. Moreover, with the help of random access memory module of 1Kbit capacity in which data are preliminary written, at a separate output of the processor under the condition that the signals from given combination of three scintillators are generated. The delay from the input to the output is not more than 35 ns. 17 refs.; 13 figs.; 1 tab.

37561 **(JINR-R—13-87-407) Time-of-flight small-angle scattering spectrometers on pulsed neutron sources.** Ostanevich, Yu.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702944/JAW.

Submitted to the Organizing Comittee of the 10. International conference on small angle scattering and applied methods, Prague, 13-16 Jul 1987.

The operation principles, constructions, advantages and shortcomings of known time-of-flight small angle neutron scattering (TOF SANS) spectrometers built up with pulsed neutron sources are reviewed. The most important characteristics of TOF SANS apparatuses are rather a high luminosity and the possibility for the measurement in an extremely wide range of scattering vector at a single exposure. This is achieved by simultaneous employment of white beam, TOF technique for wave length-scan and the commonly known angle-scan. However, the electronic equipment, data-matching programs, and the measurement procedure, necessary for accurate normalization of experimental data and their transformation into absolute cross-section scale, they all become more complex, as compared with those for SANS apparatuses operating on steady-state neutron sources, where only angle-scan is used. 28 refs.; 4 figs.

37562 **(LA-UR—88-830) Progress report on the Los Alamos tritium beta decay experiment.** Wilkerson, J.F.; Bowles, T.J.; Knapp, D.A.; Robertson, R.G.H.; Wark, D.L. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 11p. (CONF-880369—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007893/JAW.

From International symposium on neutrino mass and related topics; Tokyo, Japan (16 Mar 1988).

Measurements near the endpoint of the tritium beta-decay spectrum using a gaseous molecular tritium source yield an essentially model-independent upper limit of 27 eV on the {ovr ν}/sub e/ mass at the 95% confidence level. Since demonstrating from this initial measurement the successful operation of a gaseous source based system, most of our effort has been concentrated towards the upgrade and optimization of the experimental apparatus. The emphasis of this work has been to eliminate or further reduce effects that generate systematic errors. Based on realistic projections from our initial measurement, an ultimate sensitivity to neutrino mass of 10 eV is expected. 12 refs., 1 fig.

37563 **(LA-UR—88-1465) The USDOE mobile non-destructive assay and examination system.** Dowdy, E.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 13p. (CONF-8806151—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010958/JAW.

From U. S. DOE/DOD and CEA-France symposium; Tours, France (20 Jun 1988).

A mobile system for non-destructive assay (NDA) and non-destructive examination (NDE), developed at the Los Alamos National Laboratory, provides accurate and sensitive determination of quantities of transuranic (TRU) isotopes contained in 208-{ell} drums of wastes and furnishes images of the contents for further sorting purposes. The NDA unit consists of four major subsystems: an assay chamber, counting and digital electronics, data acquisition, and a neutron generator. It performs both active and passive neutron measurements for the determination of the amount of fissile isotopes at a sensitivity level of 1 mg plutonium, and the determina-

tion of the spontaneous fission and (α,n) isotopes at a comparable level. A complete assay consists of sequential active and passive measurements. The data analysis includes various matrix corrections and a determination that the drum does or does not exceed the 100-nCi/g threshold for TRU wastes. The NDE unit is used to examine for liquids and other materials that are prohibited for long term storage of the drums. An x-ray camera images the contents of 208-{ell} drums that are brought into the system on a conveyor and rotated in front of an x-ray source. Free liquids can be detected by shaking the drum and observing liquid motion on the video screen. Made to fit on flatbed trailers, the entire system can be transported to a Department of Energy (DOE) facility and be ready for operations within 5 hours after arrival. Field tests have been performed on three separate occasions, accomplishing more than 1800 waste drum examinations. 8 refs., 9 figs., 1 tab.

37564 **(LBL—24506) Nuclear breakup and particle densities in 200 A GeV - ^{16}O interactions with emulsion nuclei.** Adamovich, M.I.; Alexandrov, Y.A.; Asimov, S.A.; Badyal, S.K.; Basova, E.; Bhalla, K.B. (Academia Sinica, Beijing, BJ (China); Lawrence Berkeley Lab., CA (USA); CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France); Rajasthan Univ., Jaipur (India); Jammu Univ. (India); Lund Univ. (Sweden); Philipps-Univ., Marburg (Germany, F.R.); AN SSSR, Moscow. Fizicheskij Inst.; National Research Council of Canada, Ottawa, Ontario; Washington Univ., Seattle (USA); AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki; AN Uzbekskoj SSR, Tashkent. Fiziko-Tekhnicheskij Inst.). Sep 1987. Contract AC03-76SF00098. 11p. (CONF-8709152—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88005735/JAW.

From 18. international symposium on multiparticle dynamics; Tashkent, USSR (8 Sep 1987).

Experiment EMU-01 makes use of emulsion chambers and conventional stacks to study the interactions in matter of 200 A GeV ^{16}O nuclei accelerated at the CERN SPS. Projectile fragmentation is compatible with such interactions of ^{16}O nuclei at 2 A GeV, indications of limiting fragmentation. Particle production is examined via high precision pseudo-rapidity distributions. Energy densities up to about 3 GeVfm^3 are observed in central ^{16}O + Ag(Br) interactions. Pseudo-rapidity density distributions and fluctuations are well reproduced by the MC model Pritiof, although the existence of new and unknown sources of density fluctuations are not excluded by the data. 7 refs., 7 figs.

37565 **(LBL—25063) Detection of charged particles in thick hydrogenated amorphous silicon layers.** Fujieda, I.; Cho, G.; Kaplan, S.N.; Perez-Mendez, V.; Qureshi, S.; Ward, W.; Street, R.A. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 6p. (CONF-880408—18; CONF-880408—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009817/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

We show our results in detecting particles of various linear energy transfer, including minimum ionizing electrons from a Sr-90 source with 5 to 12 micron thick n-i-p and p-i-n diodes. We measured W (average energy to produce one electron-hole pair) using 17keV filtered xray pulses with a result W = 6.0 {+-} 0.2eV. This is consistent with the expected value for a semiconductor with band gap of 1.7 to 1.9eV. With heavily ionizing particles such as 6 MeV alphas and 1 to 2 MeV protons, there was some loss of signal due to recombination in the particle track. The minimum ionizing electrons showed no sign of recombination. Applications to pixel and strip detectors for physics experiments and medical imaging will be discussed. 7 refs., 8 figs.

37566 **(NUREG/CR—4728) Equipment qualification research test of a high-range radiation monitor.** Richards, E.H.; Jacobus, M.J.; Drozda, P.M.; Lewin, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 61p. NTIS, PC A04/MF A01 - GPO;1. Order Number TI88011626/JAW.

A high-range radiation detector was tested in a simultaneous steam and radiation environment simulating a postulated loss-of-coolant accident (LOCA) to assess possible synergistic effects that may be important to its performance in an accident. The detector, manufactured by General Atomic, was simultaneously subjected to a simulated accident environment including 171{degree}C (340{degree}F) steam at 410 kPa gage (60 psig) and 4 Mrad/hr gamma radiation while its performance was monitored. Test results showed that the detector successfully operated at the high dose rate and temperature, without evidence of synergisms. However, at reduced radiation levels in a saturated steam environment, the detector signal at the readout module deteriorated in accuracy or ceased altogether. The cause of these anomalies is attributed to leakage currents and/or possible galvanic action in the coaxial connections and/or cables.

37567 **(ORNL—6461) Literature survey of aerosol and iodine-vapor deposition models relevant to TVA radiation monitor sampling line conditions.** Wright, A.L. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011369/JAW.

This report describes work performed as part of a project entitled "Investigation of the Degree of Iodine Holdup in Air Monitoring Sampling Lines." The work was sponsored by the Tennessee Valley Authority as project TVA-58784A. This report, the first in a series, summarizes the available modeling data base for predicting iodine aerosol and vapor deposition in air-monitoring sampling lines. Sample aerosol and vapor deposition calculations are presented for conditions that might simulate those present in a sampling line during severe accident conditions.

37568 **(OUP—87-42) Intelligent CPIB controller.** Wikne, J.C. (Oslo Univ. (Norway). Fysisk Inst.). Dec 1987. 74p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752498/JAW.

An intelligent GPIB (General Purpose Interface Bus) controller is described. It employs an autonomous slave CPU together with a dedicated controller/talker/listener chip to handle the GPIB bus protocol, thus freeing the host computer from this time-consuming task. Distribution of a large part of the necessary software to the slave side, assures that the system can be implemented on virtually any computer with a minimum of effort.

37569 **(PPPL—2515) Relative intensities of 2.5 and 14-MeV source neutrons from comparative responses of U-235 and U-238 detectors.** Jassby, D.L.; Hendel, H.W.; Bosch, H.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1988. Contract AC02-76CH03073. 17p. (CONF-880364—27). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011166/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

The response of polyethylene-moderated U-235 fission counters is only weakly dependent on incident neutron energy, while the response of unmoderated U-238 or Th-232 fission counters increases strongly with energy. A given concentration of D-T neutrons in a mixed DT-DD source results in a unique relative detector response that depends on the parameters R14 and R2.5, where R14 is the ratio of the unmoderated U-238 and moderated U-235 detector efficiencies for a pure 14-MeV neutron source, and R2.5 is the corresponding ratio for a pure 2.5 MeV source. We have determined R14 and R2.5 using D-D and D-T neutron generators inside the TFTR vacuum vessel. The results indicate that, for our detector geometry, the ratio of U-238 to U-235 count rates should increase by a factor of about 3 when the fusion neutron source changes from pure D-D to pure D-T. This calibration is being applied to recent TFTR {open+-quotes}supersh ot{close+-quotes} data, where the uncollided neutron flux in the post-beam phase contains a high proportion of D-T neutrons from the burnup of D-D tritons. 8 refs., 4 figs,. 2 tabs.

37570 **(REG/G—8.12-Rev.2) Proposed revision 2 to Regulatory Guide 8.12: Criticality accident alarm systems: Draft Regulatory Guide.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). May 1988. 6p. United States Nuclear Regulatory Commission, Washington, DC 20555. Order Number TI88010126/JAW.

Section 70.24, "Criticality Accident Requirements," of 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," requires licensees who are authorized to possess special nuclear material in excess of certain amounts to maintain a criticality accident alarm system. This guide describes a system acceptable to the NRC staff for meeting the Commission's requirements for a criticality accident alarm system.

37571 **(SIS—1987:10) Equipment, measurement technique and annealing of LiF (TLD-100) in TL-dosimetry.** Unhjem, J.F. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1987. 31p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752499/JAW.

Results of variations in reference light, dark current, TL-signal and total background signal during a read-out series of LiF (TLD-100) crystals are presented. Also two annealing procedures are compared. The results indicate a good signal-to-noise ratio, E(S)/σ, and that a new annealing procedure takes less time to carry out. Because of the time-saving effect and the high signal-to-noise ratio, the new annealing procedure can be recommended.

37572 **(SLAC-PUB—4553) A silicon vertex detector for a B factory.** Lueth, V. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1988. Contract AC03-76SF00515. 9p. (CONF-871261—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009022/JAW.

From Workshop on B-meson factory; Courmayeur, Italy (14 Dec 1987).

The design of a Silicon vertex detector for a high luminosity e$^+$e/sup {minus/} linear collider is discussed, with emphasis on the choice of parameters for the layout, resolution and segmentation.

37573 **(UND-HEP—85-RR01) A cerium glass fiber-optic active target for high energy physics experiments.** Ruchti, R.; Baumbaugh, B.; Bishop, J.; Biswas, N.; Busenitz, J.; Cason, N.; Cunningham, J.; Gardner, R.; Grenquist, S.; Kenney, V.; Mannel, E.; Mountain, R.; Shephard, W.; Baumbaugh, A.; Knickerbocker, K.; Wegner, C.; Yarema, R.; Rogers, A.; Kinchen, B.; Ellis, J.; Mead, R.; Swanson, D. (Notre Dame Univ., IN (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL (USA); Synergistic Detector Designs, Mountain View, CA (USA); Collimated Holes, Inc., Campbell, CA (USA)). Oct 1985. Contract AC03-84ER80146;AC02-76CH03000. 5p. (CONF-851009—73). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010430/JAW.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

A fiber-optic plate imaging system has been developed for active target and tracking applications, in which the active element is Ce(3+) in a silicate glass. Particle tracks and interactions have been recorded with a hit density of {approx<-gt}4/mm for minimum ionizing particles and with a spatial resolution σ {similar<-to} 28μm.

37574 **Energy response of agar-alanine phantom dosimeter to gamma radiation.** Ciesielski, B.; Wielopolski, L.; Reinstein, L.E. (Brookhaven National Laboratory, Medical Department, Upton, New York 11973). *Medical Physics;* **15**: No. 3, 380-383(May 1988).

Calculations of the energy response of an electron paramagnetic resonance (EPR) signal induced by gamma radiation in an agar-alanine phantom dosimeter are presented. Theoretically calculated slopes of the EPR signal calibration lines are comparable with those obtained experimentally for low-(50 kVp), medium-(662 keV), and high-(15 MVp) energy photons. The sensitivity of the phantom dosimeter (EPR signal amplitude/Gray) varies less than 2% within the 150- to 20-MeV energy range. For energies above 150 keV, the influence of variations in the size of alanine crystals is negligible.

37575 **Photosensitive dopants for liquid noble gases.** Anderson, D.F. (to Dept. of Energy, Washington, DC). US Patent 4,733,085. 22 Mar 1988. Filed date 1 Jul 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method of detecting radiation with an ionization detector is described comprising the steps of: dissolving a photosensitive dopant in a noble gas; liquifying the doped noble gas; placing the doped liquified noble gas in the ionization detector; introducing radiation to be detected into the ionization detector; collecting free ions in the ionization detector; and counting the free ions collected within the ionization detector.

37576 **Fast time-to-digital converter for position-sensitive radiation detectors with delay line readouts.** Harder, J.A. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods in Physics Research;* **265**: No. 3, 500-510(15 Mar 1988). Contract AC02-76CH00016.

A fast time-to-digital converter (TDC) has been developed for use with position-sensitive radiation detectors having delay line readouts. The device is recommended for detector applications where high position resolution and low distortion are required at high rates. The device has 2 ns time resolution, less than 0.1% differential nonlinearity, and a recovery time of 70 ns. When used with a detector system having a delay line of temporal length tau, the following performance has been achieved: (1) a position digitization of 1 position resolution element per ns of delay line; (2) an average dead time of (3/4 tau + 70) ns; (3) a maximum incident radiation rate of $\approx$4/tau; and (4) a maximum conversion rate of $\approx$ 1/(3tau). Discriminator circuits reduce pile-up distortion to negligible levels for rates as high as those listed above. Finally, two converters may be connected together for synchronous operation as required by 2-dimensional (chi-γ) detectors.

37577 **Data processing and display algorithms for portable instruments.** Alley, G.T.; Bauer, M.L. (Oak Ridge National Lab., P.O. Box X, Bldg., 3500, Oak Ridge, TN (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 559-561(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Data processing and display algorithms that have general utility to the processing of statistically poor data and its subsequent presentation on digital or digitally generated analog displays have been developed for microprocessor-based portable radiation instrumentation. By using a modified exponentially weighted filter, the data displayed become easy to interpret in a much shorter amount of time than normally required. The apparent time constant can be dynamically adjusted based on the statistical validity of the data. Related algorithms are used for the simulation of an analog meter movement and handling range changing on digital displays. When used together, these algorithms produce an accurate, stable presentation of data that is also visually pleasing.

37578 **Some solutions to on-line radiological monitoring of difficult streams.** Bauer, M.L.; Ramsey, J.A. (Oak Ridge National Lab., P.O. Box X, Bldg. 3500, Oak Ridge, TN (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 571-574(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

On-line monitoring for radiological contamination of dirty, but normally not radioactive, streams is difficult. Described are several new, low-fouling units that are intended to replace the existing sensors that monitor both beta and gamma activity. A sensor was designed, using a thin-wall Geiger-Mueller tube for beta and gamma sensitivity, to monitor the influent of the sanitary sewage treatment plant. The new design eliminates dead volumes inherent in the old unit by use of a double-layer, helically wound solenoid made of 5/16-in.-OD thin-wall (0.02-in.) Teflon tubing. A 4-L Marinelli beaker-based system that used a 3 x 3 NaI(T1) scintillator was replaced with a multi-layer solenoid of 5/8-in.-OD Teflon. Two units for the detection of beta radiation are also described.

37579 **The effect of detector performance on high countrate PET imaging with a tomograph based on position-sensitive detectors.** Mankoff, D.A.; Muehllehner, G.; Karp, J.S. (Hospital of the Univ. of Pennsylvania, Dept. of Radiology, 3400 Spruce St., Philadelphia, PA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 592-597(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

During dynamic studies, ECT systems employing large position-sensitive detectors are forced to handle high event rates per detector. Since detector performance is likely to change with data rate, it is important to understand the effect of changes in detector behavior on image quality. To determine the ability of the PENN-PET tomograph to perform high countrate scans, the authors studied detector performance up to singles rates in excess of 2 million counts per second per detector. In order to evaluate the quality of images resulting from data acquired at these rates, signal-to-noise ratio analyses were applied to both simulated and experimental high countrate images of a cold spot phantom. Changes in image quality were quantitated, allowing us to test combinations of high countrate event processing techniques to produce optimal high countrate images.

37580 **Simulation studies for cylindrical positron tomography.** Stearns, C.W.; Burnham, C.A.; Chesler, D.A.; Browell, G.L. (Physics Research Lab., Massachusetts General Hospital (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 708-711(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A VMEbus-based microcomputer system has been used to implement a model for simulation of the flux of gamma rays to cylindrical PET detector systems. The model is capable of tracing over one million photons per hour, and has been used to explore some of the effects of "opening up" planar detector geometries into volumetric imagers. Gross single channel and coincidence rates can be estimated using the model, as well as the distribution patterns of both true and scattered coincidence events in the radial and axial directions. The model demonstrates the increases in scattered coincidences which are encountered in "true" (i.e. no collimation) three-dimensional PET imaging, and underscores the importance of detector energy resolution in managing scattered events. The projection plane view of scattered coincidence events suggests that scatter compensation may be attempted by filtering the projection data by two-dimensional techniques. Combining this "source" model with models of detector properties and reconstruction processes will permit a full simulation of the entire PET imaging session, with exciting prospects for system hardware and software design.

37581 **PC based analysis of gamma-ray spectra.** Chapman, T.C. (Idaho National Engineering Lab., Westinghouse Idaho Nuclear Co., Inc. P.O. Box 4000, Idaho Falls, ID (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 556-558(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

New sophisticated gamma spectral analysis software makes a personal computer based gamma spectroscopy system more capable. The personal computer employs 512 kbytes of RAM and a 20 Mbyte hard disk. Spectral analysis uses algorithms adapted from a minicomputer version of the GAUSS V code and optimized for use on a personal computer. particular care was taken to optimize the peak search and baseline determination functions. Correction for background peak contributions to the spectra is available. Detection limit values are calculated for specified nuclides which are not detected by the measurement. Nuclide identification uses a library of up to 300 nuclides with up to 24 gamma lines for each nuclide. Utilities available include nuclide library editing, energy calibration, and efficiency calibration.

37582 **Mercuric iodide photodetector-cesium iodide scintillator gamma ray spectrometers.** Markakis, J.M. (EG and G Energy Measurements, Inc., Santa Barbara Operations, Goleta, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 356-359(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Scintillation spectrometers with mercuric iodide as the photodetector were evaluated for their spectral response to gammas in the energy range of 60 keV to 1332 keV. A /sup 137/Cs (662 keV) photopeak resolution of better than 5% FWHM was obtained due to the low-noise characteristics and high-quantum efficiency of the mercuric iodide photodetector. Photopeak broadening due to the scintillator, electronic noise, and statistical noise versus gamma energy are detailed.

37583 **A rich MWPC pad readout by using Custom Microplex I.C.** Dhawan, S.K.; Grudberg, P.; Venkateramania, H.; Woods, C. (Gibbs Lab., Yale Univ., New Haven, CT (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 436-440(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Custom Microplex I.C.'s are used to directly readout 10,800 pads of a RICH photon detector MWPC. Analog pedestal substraction for every pad, digitization, sparsification and hit list are made on the fly while reading serial analog data from the microplex chips. The overall system uses less than 100 cables. Cost per channel for electronics and pads are $4.00 and $1.07 respectively.

37584 **The ring imaging Cherenkov detector for Fermilab experiment 665.** Coutrakon, G.B.; Dhawan, S.; Schuler, P. (Fermilab, Batavia, IL (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 470-474(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors describe a ring imaging Cherenkov counter (RICH) which uses a multiwire proportional chamber (MWPC) with cathode pad readout as a UV photon detector. The detector has 10800 pads, each connected to a charge sensitive amplifier, within an area of 55 x 95 cm/sup 2/. The detector offers high data rate capability and a chamber sensitive time of less than 250 nsec. In addition, the detector has 1 mm spatial resolution and a multi-hit capability of about 50 photons/event.

37585 **Low-background-rate detector for ions in the 5- to 50-keV energy range to be used for radioisotope dating with a small cyclotron.** Friedman, P.G. Berkeley, CA; Univ. of California (1986). 79p. University Microfilms Order No. 87-17,982.

Thesis (Ph. D.).

Accelerator mass spectrometry in tandem Van de Graaff accelerators has proven successful for radioisotope dating small samples. Small, inexpensive cyclotrons serving this purpose would make the technique accessible to more researchers and inexpensive enough to compare many small samples. To this end, VC Berkeley is developing a 20-cm-diameter, 30- to 40-keV cyclotron dedicated to high-sensitivity radioisotope dating, initially for ^{14}C. At this energy, range and dE/dx methods of particle identification are impossible. Thus arises the difficult problem of reliably detecting 30- to 40-keV ^{14}C at 10^{-1} counts/sec in the high-background environment of the cyclotron, where lower energy ions, electrons, and photons bombard the detector at much higher rates. To meet this challenge, an inexpensive, generally useful ion detector was developed that allows dark-count rates below 10^{-4} counts/sec and excellent background suppression. With the cyclotron tuned near the ^{13}CH background peak, to the frequency for ^{14}C, the detector suppresses the background to 6 x 10^{-4} counts/sec. For each ^{14}C ion, the detector's grazing-incidence Al_2O_3 conversion dynode emits about 20 secondary electrons, which are independently multiplied in separate pores of a microchannel plate. The output signal is proportional to the number of secondary electrons, allowing pulse-height discrimination of background.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 36983, 37379, 37382, 37388

37586 (AERE-R—12916) CREAM - a Cosmic Radiation Effects and Activation Monitor for space experiments: Pt. 1. Design and construction of experimental packages for flight on a NASA Shuttle mission. Mapper, D.; Stephen, J.H.; Farren, J.; Stimpson, B.P.; Bolus, D.J.; Ellaway, A.M. (UKAEA Harwell Lab. Instrumentation and Applied Physics Div.). Dec 1987. 64p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753984/JAW.

Final report for RAE, Farnborough.

A detailed account is given of the design and construction of the experimental CREAM packages, intended for flight in the mid-deck area of the Space Transport System (Shuttle) Mission in 1986. The complete experiment involved; 1) a self-contained and battery powered activation monitor for measuring energy losses of charged particles; 2) CR-39 and Kapton polymer solid state nuclear track detectors for the detection of ionising particles; 3) metal foils of nickel, titanium and gold for neutron monitoring; and 4) thermoluminescent detectors for dosimetry measurements of the radiation background. The circuit design and detailed functioning of the active monitor is fully described, together with a complete discussion of the principles and operation of the passive monitors.

37587 (IKF-IB—66) Description of the universal low-temperature measuring system. Langfeld, R.; Maurer, C. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik). Jan 1987. 70p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753549/JAW.

There are various measuring methods for a characterization of semiconductor devices, especially for analysis of radiation effects after ion implantation. The four most important methods are: 1. Recording of voltage-current characteristics at pn-junctions or Schottky diodes. 2. Determination of the temperature dependence of the electrical resistance, e.g. of amorphous semiconductor layers, by feeding a constant voltage and measuring the current as a function of sample temperature. 3. Measurement of the resistive layer capacitance of a semiconductor diode as a function of the fed blocking voltage and determination of the doping concentration profile. 4. Time-resolved capacitance measurement after abrupt blocking-voltage alterations at pn - or Schottky diodes as a function of specimen temperature for determining defects in semiconductors, DLTS method. A measuring equipment has been set up that allows measurements being made in the temperature range between 14 K and 400 K, on up to eight specimens in one temperature test. Operating mode and handling of the computerized measuring program are described.

37588 (SAND—88-0250C) Evaluation of silicon-on-insulator MOS [metal-oxide-semiconductor] transistor response to 10-keV x-ray and cobalt-60 irradiation. Fleetwood, D.M.; Tsao, S.S.; Winokur, P.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880730—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88006102/JAW.

From 25. annual conference on nuclear and space radiation effects; Portland, OR, USA (12 Jul 1988).

This front-gate, back-gate, and sidewall response of SIMOX and ZMR MOS transistors to 10-keV x-ray and Co-60 irradiation is compared for SOI devices with and without hardened sidewall passivation. 14 refs., 4 figs.

37589 Total-dose failure mechanisms of integrated circuits in laboratory and space environments. Winokur, P.S.; Sexton, F.W.; Hash, G.L.; Turpin, D.C. (Sandia National Labs., Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1448-1454(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

Total-dose failure mechanisms are identified over a wide range of dose rate for 2K and 16K SRAMs from hardened and commercial CMOS technologies. Failure was defined "parametrically," such that an IC fails if one of its parameters, e.g., static power supply current or timing, exceeds a preset specification following irradiation. These studies demonstrate that the dominant failure mechanisms of SRAMs in space radiation environments are often quite different than those observed at considerably higher laboratory dose rates specified by DoD test guidelines, i.e., 100 to 300 rad(Si)/s. In addition, the total-dose hardness of SRAMs varied significantly between laboratory and space dose rates. Several approaches are discussed for predicting total-dose hardness of ICs in space from laboratory measurements. Results are also presented for transistors irradiated over the same range of dose rate (200 to 0.02 rad(Si)/s) and at all biases, i.e., N-on/off and P-on/off. These transistor measurements are used to characterize the physical mechanisms that govern the radiation response of the more complex SRAMs. In a surprising result, a dose-rate dependence for the buildup of radiation-induced interface states was observed. At dose rates from 200 to 0.02 rad(Si)/s, the number of interface states at a given total dose increased as the dose rate decreased.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 35625, 36581, 36644, 36764, 37025, 37037, 37292, 37666, 37694, 38656, 38813, 38822

37590 (CONF-880277—2) A new automated continuous emissions monitor for incinerators. McIntosh, M.J.; Erickson, M.D.; Demirgian, J.C. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010031/JAW.

From Pacific Basin conference on hazardous waste; Honolulu, HI, USA (1 Feb 1988).

Many of the problems as well as the needs of hazardous waste incineration (HWI) are related to stack emissions measurements. In this paper these problems and needs are briefly outlined and some of the characteristics a desired monitor should have are discussed. The theory of Fourier Transform Infrared Spectroscopy (FTIR) and its advantages are discussed. Some recent results are given relative to emissions monitoring by a system based on FTIR, which show that many of the monitoring needs of HWI may be met by such a system. Some of the future possibilities for this type of monitoring are discussed.

37591 (CONF-880740—4) Some observations of acoustic cavitation in water at 1 MHz. Cha, Y.S.; Sheen, S.H.; Lawrence, W.P.; Raptis, A.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 21p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010079/JAW.

From Cavitation and multiphase forum; Cincinnati, OH, USA (24 Jul 1988).

The results are summarized: (1) Nuclei distrubution in fresh tap water changes rapidly with time within the first hour after water has been poured into the tank. It is difficult to reproduce the experimental results at relatively low powers within this period. (2) The most violent action (cavitation and streaming) was observed in tests with fresh tap water. The presence of a reflector enhanced the cavitation activity significantly. Stable bubble pattern with stationary bubbles were observed for most of the tests conducted with a long waiting time and without the presence of a reflector. (3) Sometimes four distinctive types of bubble behavior can be observed in one experiment. For example, at relatively high powers in tests with long waiting time and with the presence of a reflector, it was observed that there were stationary bubbles, rising bubbles, dancing bubbles, and streaming bubbles. (4) For tests conducted with long waiting time, no bubbles were observed even when input power was increased to a very high values (100 volts). However, bubbles can be made to appear suddenly by pertubing the frequency away from 1 MHz. Once the bubbles appear, they remain even when the frequency is returned to 1 MHz. This triggering phenomenon may be partly related to hysteresis. (5) The bubbles are gas (not vapor) since most of them gradually rise to the surface when the power is turned off. (6) At relatively high powers ({approximately 100 volts}, strong streaming and pulsing were observed. A group of bubbles was observed to move suddenly in the

direction away form the transducer. This pulsing action does not occur at a fixed interval. 9 refs., 8 figs.

37592 **(CONF-8708180—12) Experimental demonstration of producing high resolution zone plates by spatial-frequency multiplication.** Yun, W.B.; Howells, M.R. (Argonne National Lab., IL (USA); Lawrence Berkeley Lab., CA (USA)). 1987. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88012032/JAW.

From Symposium on X-ray microscopy; Upton, NY, USA (31 Aug 1987).

In an earlier publication, the possibility of producing high resolution zone plates for x-ray applications by spatial-frequency multiplication was analyzed theoretically. The theory predicted that for a daughter zone plate generated from the interference of mth and nth diffraction orders of a parent zone plate, its primary focal spot size and focal length are one (m + n)th of their counterparts of the parent zone plate, respectively. It was also shown that a zone plate with the outermost zone width of as small as 13.8 nm might be produced by this technique. In this paper, we report an experiment which we carried out with laser light (λ = 4166A) for demonstrating this technique. In addition, an outlook for producing high resolution zone plates for x-ray application is briefly discussed.

37593 **(DOE/ER/13487—3) Effects of the nature of the solvent and solutes on the response of a light scattering detector.** Righezza, M.; Guiochon, G. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA)). [1988]. Contract FG05-86ER13487. 50p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010648/JAW.

The effects of the nature of the solvent and solutes on the response of an evaporative light scattering detector (ELSD) are discussed. Data have been measured for six solutes with seven different solvents using concentric and cross-flow nebulizers. The experimental results suggest that the influence of the solvent on the properties of a dried aerosol are not properly accounted for by the equation of Nukiyama and Tanassawa. A modification of the droplet size distribution of the aerosol takes place, probably during the vaporization of the solvent. The amount of scattered light depends strongly on the molar absortivity of the solute at the light beam wavelength. Accordingly, the detector response depends on the properties of the solvent and the solute. The ELSD is not a mass detector and calibration is required for quantitative analysis. 19 refs., 9 figs.

37594 **(DOE/ER/13718—1) Fourth international symposium on accelerator mass spectrometry: Program and abstracts.** (Rochester Univ., NY (USA)). 1987. Contract FG02-87ER13718. 132p. (CONF-8704112—Absts.). NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88008765/JAW.

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

This report contains abstracts of papers on mass spectrometry from the international symposium on accelerator mass spectrometry. (LSP)

37595 **(EGG—10617-5003) Streak tube evaluation procedures at EG&G/EM, Los Alamos Operations.** Baker, S.; Whiteson, A.; Jennings, T. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations). May 1988. Contract AC08-88NV10617. 63p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009567/JAW.

This manual describes the tests used at EG and G Energy Measurements, Inc., Los Alamos Operations (LAO) to characterize streak tubes. Both resolution (static, dynamic spatial, and dynamic temporal) and radiometric (linearity and radiant gain, extinction ratio, opacity, and quantum efficiency/photocathode uniformity) measurements are covered,a nd the significance of these measurements with respect to streak camera applications is discussed. Results from characterization tests done on a typical streak tube have been included in these tests as examples.

37596 **(GKSS—86/E/69) Computer controlled microdensitometer and some applications.** Greim, L.; Greim, M.; Schmitz, H.W.; Schumacher, G.W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 11p. (CONF-8606235—). Reprint from: Barton, J.P.; Farny, G.; Person, J.L.; Roettger, H. (eds.): Neutron radiography. Proceedings of the 2. world conference. Dordrecht: Reidel (1986) p. 669-677.

From 2. world conference on neutron radiography; Paris, France (16 Jun 1986).

Microdensitometry on neutron radiographs enables quantitative evaluations of images. The measuring set up presented consists of the Jenoptic Schnellphotometer G III with several essential alterations and extensions. The densitometer was equipped with a photodiode which has a fast and linear response over a measuring range of 6 powers of ten. A travelling tabel can be moved by step motors in x- and y-directions over an area of 150x250 mm, step length 10 μm. The scanning program is controlled by minicomputer, with a speed of about 5 measurements per second. Data processing and evaluation is done on- and off-line. Some applications are presented: the examination of several resolution functions, as well as the scanning and fitting for the evaluation of radiographs of the Euratom calibration fuel pin and of the AFNOR IQI and of a proposed L/D standard.

37597 **(IAE—4426/14) Four-channel digital recording system of single process form for study solid properties in pulsed high magnetic fields.** Bessonova, N.A.; Kapustin, G.A.; Meleshko, E.A.; Morozov, A.G.; Olejnik, S.V.; Ostashev, I.E.; Palkin, Yu.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702855/JAW.

The four-channel measurement system developed for high-efficiency digital recording and reproduction of the single and rare-recurrent process shape is considered. The 10-capacity bipolar analog-to-digital converter (ADC) with maximum frequency of quantization 10 MHz is used in the system. The measurement system is designed for carrying out investigations related to the effect of pulsed high magnetic fields on solids. Problems concerning the development of high-speed pulse signal recorders based on specialized ADC are considered. Short notices of measurement system operation at the installation for pulsed high magnetic fields are given. 15 refs.; 6 figs.

37598 **(IFVE-OP—87-122) Hardware and software for TV measurement technique study.** Gusak, A.A.; Dubasov, Yu.B.; Novikov, V.N.; Romanov, Yu.A.; Serga, E.V.; Kharlamov, A.V.; Khodyrev, Yu.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702860/JAW.

Hardware and software which allow to build a model of TV measurement system, to study its parameters and to train measurement algorithms are considered. The capabilities of the complex offered are shown at the examples of TV systems for image analysis in microscopy, beam diagnostics and parameter measurements of the position sensitive photodetectors. 18 refs.; 12 figs.

37599 **(ITEF—140(1987)) SM computer interface with ADAPTER non-standard external equipments.** Bezuglov, M.P.; Bobchenko, B.M.; Gushchin, O.B.; Zhurkin, V.V.; Zavrazhnov, G.N.; Sergeev, N.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702888/JAW.

SM computer interface with ADAPTER non-standard external equipments is described. The communication system developed is constructed according to the principle of independent interface units, every of which provides the communication with the external equipment. A flowsheet of the "ADAPTER", which main elements are an address switch, an address decorder, a data switch and a

control device for "ADAPTER" operating in program and direct memory access modes, is presented. Sampling of addresses for non-standard external equipments and algorithms of block operation in different exchange modes are considered. 3 figs.

37600 **(JINR-R—10-87-550) CAMAC interface with a micro-computer.** Le Dinh Lam; Nguyen Ngoc Hoan; Nguyen Manh Shat. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Inst. Fiziki NTsNI, Khanoj, SRV). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702938/JAW.

The CAMAC interface with the M6800 micro-computer is described. A new approach to criterion of the CAMAC controller is developed. It permits to provide the increase in the reliability of data acquisition system in physical experiments, as well as that of storage and data processing. Algorithm of program for data reading from 2249A ADC unit is described. The interface is located in a single CAMAC module and occupies the 25th position in crate. The velocity of data transfer between micro-computer and CAMAC system is 1 Mbit/s. 4 refs.; 2 figs.; 1 tab.

37601 **(LA-UR—88-1303) An electronic shadowgraph station and control system.** Holt, D.M.; Winchenbach, G.L. (Los Alamos National Lab., NM (USA); Air Force Armament Lab., Eglin AFB, FL (USA)). 1988. Contract W-7405-ENG-36. 10p. (CONF-880592—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009122/JAW.

From 15. AIAA aerodynamic testing conference; San Diego, CA, USA (18 May 1988).

A proof-of-principle electronic shadowgraph station has been installed at the Aeroballistic Research Facility, Eglin Air Force Base, Florida, with encouraging results. This paper reviews the requirements for replacing a film system for aeroballistics measurements with an electronic imaging and processing system, with particular emphasis on using centroid and second moment of inertia algorithms to improve the accuracy. The proof-of principle electronic shadowgraph station is described and results of comparative measurements at the facility between film and digitized video images show comparable accuracy. 6 refs., 16 figs., 2 tabs.

37602 **(LBL—23988) Microprocessor-controlled personal dosimeter for recording low-intensity, power-frequency magnetic fields.** Tenforde, T.S. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 51p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008404/JAW.

A portable dosimeter has been developed for monitoring human exposure to power-frequency magnetic fields in residential and occupational environments. This microprocessor-controlled dosimeter has been designed to measure 60-Hz field intensities from 20 μG to 600 mG (r.m.s. values), thereby covering the broad range of field levels generally encountered in households and occupational settings. Field detection is accomplished by three orthogonal 500-turn coils, each of which is enclosed in a copper chamber to provide shielding from ambient electric fields. A digitized resolution of 2.5 μG is provided in the 20 μG to 10 mG range, and 150 μG resolution in the 10 mG to 600 mG range. A bench-mounted HP85 computer is used to initialize the data acquisition program during start-up of the portable dosimeter. The HP85 also retrieves data from the random-access memory through an RS-232-C serial interface when the field monitoring is completed. Calibration tests have demonstrated that linearity of the dosimeter's detection system is within 2% over the field range of 50 μG to 600 mG. Contamination of the main 60-Hz signal by harmonics was found to be less than 1%. Tests of the dosimeter's performance in an electronics laboratory, a 230-kV substation, and a residential environment have demonstrated that it meets the original design specifications. Several design improvements that would reduce the dosimeter's physical size and extend its versatility for long-term field monitoring are discussed.

37603 **(PNL—6537) Direct measurement of solids: High temperature sensing: Experimental development and testing of high temperature pulsed EMATs [electromagnetic acoustic transducer]: Final report.** Boyd, D.M.; Spanner, G.E.; Sperline, P.D. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 60p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009859/JAW.

A pulsed laser/pulsed EMAT (electromagnetic acoustic transducer) receiver system has been demonstrated for measuring the time of flight of acoustic signals in hot steel samples. Attenuation and signal-to-noise ratio are important parameters to be monitored. A continuous contact EMAT application was not achieved; thermal analysis found that contact times of 5 seconds with cooling times of 45 seconds are required at 1300{degree}C. The equipment requires field hardening and improved packaging before system reliability can be assessed. 22 refs., 35 figs. (DLC)

37604 **(PNL-SA—14755) US Department of Energy Radiological Calibration Intercomparison Program.** Cummings, F.M.; Endres, G.W.R. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 4p. (CONF-880404—7). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008192/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

This paper discusses the procedures and equipment used in the United States Department of Energy Radiological Calibration Intercomparison Program. (LSP)

37605 **(SAND—88-0197C) Acoustic plate mode devices as liquid phase sensors.** Ricco, A.J.; Martin, S.J.; Frye, G.C.; Niemczyk, T.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-8806132—1). NTIS, PC A03/MF A01. Order Number TI88010227/JAW.

From Solid state sensors workshop; Hilton Head, SC, USA (6 Jun 1988).

Acoustic plate mode (APM) devices are sensitive to mass accumulated on and removed from a solid surface immersed in a liquid, as well as solution viscosity, density, electrical conductivity, and dielectric coefficient. Operating in direct contact with liquid solution at 158 MHz, APM devices have been used to monitor electrodeposition, electroless deposition, and metal film corrosion. Calibration of a 0.19 mm thick ST-quartz APM sensor by vacuum deposition of a silver film yielded a sensitivity of less than 1 ng/cm^2. Comparison of the frequency shift during Ag deposition to that obtained upon aqueous dissolution of the same Ag film demonstrates that the sensitivity to mass loading is not measurably altered by liquid contacting the device surface. Monitoring the propagation loss of the acoustic wave, which is proportional to viscosity over the 0.3 to 80 cP range, allows use of an APM device as a solid-state viscosity sensor. Acoustoelectric coupling between the APM and solution results in a velocity perturbation which depends on ionic conductivity and solution dielectric coefficient. 16 refs., 5 figs.

37606 **(Y/DW—781) Acoustic emission calibration instrumentation.** Duncan, M.G.; Whittaker, J.W. (Oak Ridge Y-12 Plant, TN (USA)). 13 Nov 1987. Contract AC05-84OS21400. 34p. (CONF-880425—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010817/JAW.

From IEEE instrumentation and measurement technology conference; San Diego, CA, USA (20 Apr 1988).

An automatic calibration instrument was developed to improve calibration accuracy of acoustic emission (AE) transducers by one order-of-magnitude over commercially available equipment. The instrument facilitates calibration by automatically displaying the maximum value of the stress used to produce AE calibration pulses and the AE pulse. Low-noise amplifiers and filters were also developed to improve the sensitivity of AE measurements by more than one order-of-magnitude over commercially available instruments; thus smaller signals may be detected in parts. 1 ref., 10 figs.

37607 **Atmospheric isoplanatism and astronomical image reconstruction on Mauna Kea.** Cowie, L.L.; Songaila, A. (Institute for Astronomy, University of Hawaii, 2680 Woodlawn Drive, Honolulu, Hawaii 96822). *Journal of the Optical Society of America A: Optics and Image Science;* 5: No. 7, 1015-1022(Jul 1988).

Atmospheric isoplanatism for visual wavelength image-reconstruction applications was measured on Mauna Kea in Hawaii. For most nights the correlation of the transform functions is substantially wider than the long-exposure transform function at separations up to 30 arcsec. Theoretical analysis shows that this is reasonable if the mean Fried parameter is approximately 30 cm at 5500 A. Reconstructed image quality may be described by a Gaussian with a FWHM of λ/s_0. Under average conditions, s_0 (30 arcsec) exceeds 55 cm at 7000 A. The results show that visual image quality in the 0.1—0.2 arcsec range is obtainable over much of the sky with large ground-based telescopes on this site.

37608 **Static gas analysis by a transient flow technique.** Leckey, J.H.; Boeckmann, M.D. (Oak Ridge Y-12 Plant, Chemistry and Chemical Engineering Department, Development Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 4, 2514-2517(Jul 1988).

A technique is presented for using a residual gas analyzer (RGA) to analyze small concentrations of heavy gases in lighter gases in a static volume of <10 cm^3. Passing the gas sample through a control valve causes it to enter the RGA chamber in molecular flow. This procedure results in fractionation that causes enrichment of the heavier gas during the evacuation of the sample, giving rise to a significantly higher heavy gas signal near the end of the evacuation, while maintaining low pressures in the RGA chamber that are required for linearity. This heavy gas enrichment near the end of the evacuation results in a significant reduction in its detection limit. Specific examples are presented for the analysis of argon in hydrogen and are compared to a gas-flow model of the system.

37609 **Polarization analyzer for high energy pulsed laser beams.** Roberts, T.G.; Otto, W.F.; Gamble, W.L.; Honeycutt, T.E. (to Secretary of the Army, Washington, DC). US Patent 4,737,643. 12 Apr 1988. Filed date 30 Dec 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A polarization analyzer for an energy laser beam is described comprising a wire resistor wound such that it presents straight line segments each in a single plane and parallel to each other, first means connected to the resistor so as to position the plane such that the laser beam will be substantially perpendicular to the plane and will impringe on at least a portion of the segments so as to cause heating of the resistor in accordance to the average power output of the beam and its polarization position relative to the alignment of the segments. First measurement means connect to the wire resistor for measuring the resistance of the resistor. One raceway means connect to the first means so as to allow rotation of the segments within the plane. Second measurement means connect to the first means and the raceway means for measuring the angle of rotation of the segments relative to a predetermined angle position of the segments relative to the raceway, and the first means are rotated so as to allow measurements to be made about the angles of rotation of the segments.

37610 **Josephson junction q-spoiler.** Clarke, J.; Hilbert, C.; Hahn, E.L.; Sleator, T. (to Dept. of Energy, Washington, DC). US Patent 4,733,182. 22 Mar 1988. Filed date 25 Mar 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a detection system for detecting the gyroprecessional resonance of a specimen having a particle system with magnetic or electric dipole moments comprising: means for irradiating the specimen with a pulse of high frequency radiation, detector means for detecting signals produced by magnetic resonance of the specimen, a dc SQUID having a superconducting ring and two shunted Josephson tunnel junctions interrupting the ring, the ring having a bias current input at one side thereof between the junctions and a bias current output at the other side thereof between the junctions, means for establishing a constant magnetic flux threading the SQUID ring, means for supplying a bias current to the bias current input of the SQUID, an input coil inductively coupled to the SQUID ring, and a resonant circuit coupling the detector means to the input coil.

37611 **Sphericity measurements of full spheres using subaperture optical testing techniques.** Beery, T.A.; Lawrence, G.N.; Day, R.D. (Los Alamos National Lab. (US)). pp 334-341 of Optical testing and metrology. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

This paper discusses the progress being made on the development of applying subaperture interferometric testing techniques to making sphericity measurements on the entire surface of a full sphere.

4404 Well Logging Instrumentation

37612 **Neutronic properties of Mesaverde Sands: Pt. 2. Results.** Lysne, P. (Sandia National Labs., Albuquerque, NM (USA)). *Nuclear Geophysics;* 2: No. 2, 113-122(1988).

Thermal neutron absorption cross section measurements were conducted on one hundred and twenty specimens obtained from the Mesaverde formation. Specimens comprised entirely of claystone, mudstone, siltstone and coal were found to have the largest cross sections with typical values in the range of 6-10 CU(gmcm^3). Alternatively, specimens with 1% or less clast or parting material, possess cross sections of 4.2 +- 0.6 CU(gmcm^3) for Mesaverde as a whole, whereas some individual units are characterized by nearly uniform cross section values. A petrographic analysis enabled an estimate of the shale water content and this information, together with the cross section values, was used to estimate the uncertainty in neutron porosity logs. This uncertainty is about +- 3 volume percent and it is due more to uncertainty in the shale water content than to jitter in the matrix cross section values.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 36435, 37247

37613 **(AD-A—190124/8/XAB) Buckling of blast-loaded cylinder. Final report, 1985-1986.** Santiago, J.M.; Klaus, M.H.; Wisniewski, H.L. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Oct 1987. 52p. (BRL-TR—2863). NTIS, PC A04/MF A01.

The transient response of a thin-walled aluminum cylinder subjected to an enveloping shock wave was simulated with the ADINA finite-element program, and the results are compared with counterpart experimental data. The analysis employed the ADINA 16-noded rectangular curved shell. Using linear analysis, the computed strain histories at gage locations were found to correlate reasonably well with test records for the first four milliseconds, but some strain records rapidly diverged thereafter. A subsequent nonlinear analysis showed dynamic buckling to be the principal cause of this discrepancy. The nonlinear calculations and test results were found to generally agree in the number of buckling nodes, The magnitude of the deformation, and frequencies excited, although buckling sensitivity to imperfections prevented an exact coincidence of circumferential modes.

37614 (AD-A—190607/2/XAB) Dynamic test of a corrugated steel keyworker blast shelter MISTY PICTURE. Final report. Holmes, R.L.; Slawson, T.R.; Harris, A.L. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Nov 1987. 93p. (WES/TR/SL—87-31). NTIS, PC A05/MF A01.

The 18-man blast shelter was tested dynamically on May 14, 1987 in the MISTY PICTURE event at White Sands Missile Range, NM. The main section of the shelter was fabricated from a 9-foot-diameter, 27.5-foot-long section of 10-gage, galvanized, corrugated steel culvert. The shelter included a vertical entryway and air intake and exhaust stacks. The shelter design was found to be conservative during a previous 50-psi validation test, and some constructibility problems were encountered with the entryway-to-shelter connections. This test was conducted to validate the modifications made to the shelter design. The modifications were made to reduce construction costs and improve constructibility. Primary modifications included: replacing the stiffened endwalls with lighter-weight unstiffened plates, connecting the entryway to an endwall rather than to the main section of the shelter, and the inclusion of an emergency exit. The structure was located at the anticipated 200-psi peak overpressure level. Post-test inspection revealed that the main section of the shelter suffered very little damage during the test. Due to the failure of the emergency exit cover plate, it was necessary to determine if enough pressure entered the shelter to affect its structural response. This test also investigated the shock environment inside the shelter.

37615 (CONF-880724—20) Experimental and analytical study of vapor explosions in stratified geometries. Anderson, R.; Armstrong, D.; Cho, D.; Kras, A. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011964/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

Vapor explosions in stratified geometries were experimentally studied. The unpredictable stability of stratified systems in a horizontal orientation made them poor experimental subjects. Stratified explosions were successfully generated in a vertical, transparent, fully confined pressure vessel. The explosion propagated with a sharp front and a narrow reaction zone where the two liquids mixed and the cold liquid boiled. Behind the explosion wave the system was in local equilibrium. If two liquid layers of the same thickness mixed and came to 100% equilibrium they would need a total mixture depth of 6 mm to explain the measured equilibrium pressure. Less efficient reactions would require greater mixing depths. A comprehensive model of stratified explosions must include the strong two-dimensional effects.

37616 (LA—11239-MS) Numerical modeling of the effect of particle size of explosives on shock initiation properties. Mader, C.L.; Kershner, J.D. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 22p. NTIS, PC A03. Order Number DE88010479/JAW.

The three-dimensional Eulerian reactive hydrodynamic code 3DE has been used to investigate the effects of particle size and the resulting void or hole size on the shock initiation of heterogeneous explosive charges of TNT. Shocks interacting with TNT containing various hole sizes have been modeled. The void fraction was held at 0.5% while the spherical hole sizes were varied from 0.5- to 0.0005-mm radius, and the TNT was shocked to 12.5 GPa. As the hole size was varied from 0.5 to 0.05 mm, the explosive became more sensitive to shock as the hole size decreased, and the number of hot spots increased. When the hole size was decreased to 0.0005 mm, a 12.5-GPa shock wave failed to build toward propagating detonation because the resulting hot spots were cooled by side rarefactions before appreciable decomposition occurred. At the same density, the most shock-sensitive explosive will be that with particle sizes between coarse and extremely fine material. 11 refs., 6 figs., 2 tabs.

37617 (LA-UR—88-1157) Decomposition of energetic materials on the drop-weight impact machine. Buntain, G.A.; McKinney, T.; Rivera, T.; Taylor, G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-880693—3; CONF-880693—). NTIS, PC A03;3. Order Number DE88009154/JAW.

From 19. international ICT conference on combustion and detonation; Karlsruhe, F.R. Germany (29 Jun 1988).

The drop-weight impact test is essential for initial characterization of limited amounts of new energetic materials. The mechanisms for reaction of energetic materials on the drop-weight machine are largely unknown. Partly as a consequence of this lack of understanding, results obtained on the drop-weight machine are often misleading and inconsistent. We are investigating mechanisms for decomposition of explosives on the drop-weight machine using radiometric and spectroscopic methods. Initial radiometric results reveal consistent, sequential emissions for specific impacted explosives that probably correspond to time-resolved chemical reactions. Time-resolved C_2^* emission has been tentatively identified using spectroscopic methods to examine impacted explosives. 11 refs., 9 figs.

37618 (MLM—3505) Relative flow rates of explosive powders. Willson, V.P. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 31 May 1988. Contract AC04-76DP00053. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010767/JAW.

A study was performed to determine the relative flow rates of various explosive powders and evaluate their adaptability for use in automated dispensing systems. Results showed that PBX 9407, LX-15, RX-26-BH, and HNAB are potential candidates for use in these systems. It was also shown that powders with graphite and stearate additives generated the least amount of static and were the easiest to handle.

37619 (SAND—87-3032C) Diode laser ignition of high explosives and pyrotechnics. Kunz, S.C.; Salas, F.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 19p. (CONF-880750—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008771/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

Thermal ignition of the explcsive CP (2-[5-cyanotetrazolato]pentaamine cobalt (III) perchlorate) and of the pyrotechnic Ti/$KClO_4$ has been achieved using a (GaAl)As diode laser that emitted 1 watt of optical power from the end of a 100{minus}μm core fiber optic to which it was coupled. The wavelength of the emitted light was near 820 nm. Approximate ignition thresholds were obtained for pulse widths of between 2 and 10 ms. For a 10{minus}ms pulse width, pure CP required {approximately}6.7 mJ of energy for ignition whereas pure Ti/$KClO_4$ required only {approximately}3 mJ. Dopants such as carbon black, graphite and a laser dye were added in small concentrations to enhance light absorption and thereby reduce the ignition theshold. Their effects as well as those of powder density, particle size and spot size of the incident light on ignition threshold are described. 9 refs., 7 figs., 3 tabs.

37620 (SAND—87-3069C) A concept for an electro-optic explosive device. Benson, D.A.; Rose, B.H. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 20p. (CONF-880750—6). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009696/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

Enhancement of the safety and security of explosive devices by solely using fiber optic links to the device has been a development objective in both commercial and military applications. Much effort has centered on the direct ignition of explosive materials by light from an optical fiber. While such devices are beginning to emerge, the need to use high optical power levels ans sensitive explosives has limited the approach. We have explored an indirect, but simple approach to operating an optically coupled detonator/igniter. This method is made possible by recent developments in low voltage explosive igniters combined with microcircuit series-

connected photovoltaic arrays. They allow one to convert light from an optical fiber to electrical energy stored in a small capacitor and to trigger its discharge, all locally within the device to produce a precisely timed explosive ignition and subsequent detonation. This produces a component of about the same size as existing devices, which is highly resistant to electromagnetic disturbances and driven by a diode laser through an optical fiber. The method functions with a wide range of insensitive secondary explosives and pyrotechnics. In this paper we will describe prototypes of the device which we have operated. Performance ranges available with present technology and areas of technology which will be fruitful to develop will be discussed. 15 refs., 9 figs., 1 tab.

37621 **(SAND—87-3095C1) Semiconductor bridge (SCB) igniter studies: 1, Comparison of SCB and hot-wire pyrotechnic actuators.** Bickes, R.W. Jr.; Schlobohm, S.L.; Ewick, D.W. (Sandia National Labs., Albuquerque, NM (USA); Monsanto Research Corp., Miamisburg, OH (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880750—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008802/JAW.

From 13. international pyrotechnics seminar; Grand Junction, CO, USA (11 Jul 1988).

Sandia National Laboratories has developed a means for igniting pyrotechnics, propellants and primary or secondary explosives using a semiconductor bridge (SCB) instead of the small metal bridgewires, called hot wires, conventionally used for explosive components. The SCB is a heavily n-doped silicon film, typically 100 μm long by 380 μm wide by 2 μm thick, which when driven with a short (20 μs), low-energy current pulse (less than 3 mJ), generates a hot plasma that ignites the explosives. We report in this paper a study of pyrotechnic actuators built with SCB igniters in which we obtained the Langlie All-Fire, Langlie No-Fire and Electrostatic Discharge (ESD) characteristics. Two SCB designs were tested. The first (designated as a type 3-2) was the rectangularly shaped bridge described above. The second (designated as a type 15) included a modification of the rectangular bridge consisting of a narrow waist region. We compare our data for these prototype SCB components with the same actuators built with conventional hot-wire igniters. The results obtained demonstrated the main characteristics of SCB devices: (1) the SCB actuators functioned at one-tenth the input energy of the hot-wire actuators, (2) had higher no-fire currents than the hot-wire devices, (3) passed ESD tests, and (4) functioned in a few tens of microseconds versus the millisecond response of the hot-wire components. 8 refs., 5 figs., 3 tabs.

37622 **A numerical investigation of high-explosive grain size effects on the performance of boosters.** Tang, P.K. (Los Alamos National Lab., NM (US)). *Combustion and Flame;* 70: No. 1, 61-64(Oct 1987).

Initiation of insensitive high explosives requires use of a boosting system with a more sensitive and typically more energetic explosive. However, problems arise if the booster material is too energetic. The initiability of some insensitive but not so energetic high explosives can be enhanced by lowering the density and decreasing the grain size; thus those explosives can be used as booster materials. A class of experiments, commonly called onionskins, has been used to detect the divergence pattern of the detonation wave and determine the performance of the booster. With reactive burn model in a hydrodynamic code, numerical simulations can be performed to obtain the same objectives. Examples are presented using low-density superfine and ultrafine triaminotrinitrobenzene (TATB) as booster explosives to initiate plastic-bonded TATB-base high explosive.

4502 Nuclear

REFER ALSO TO CITATION(S) 36167, 36715, 37634, 37714, 37765

37623 **(AD-A—190478/8/XAB) Geophysical investigations at Pahute Mesa, Nevada. Final report, 1 February 1985-31 January 1987.** Ferguson, J.F.; Reamer, S.K. (Texas Univ., Dallas (USA)). 12 Aug 1987. 132p. NTIS, PC A07/MF A01.

The seismic response of underground nuclear explosion tests at Pahute Mesa, NV displays variations that correlate with the geologic/geophysical structure. Investigations were performed using borehole, gravity, and wide-angle seismic observations, with the aim of producing a geophysical model of the Silent Canyon caldera structure at Pahute Mesa. Empirical models of the density and seismic velocity were formulated, based on well logs. New gravity stations were obtained in 1985 and merged with older, lower-quality data. A new gravity-modeling technique was developed and applied to the modeling of a transect across the area. The resulting model supports the hypothesis that a high density and velocity blanket at a depth of a few kilometers. In 1986 a wide-angle seismic reflection/refraction survey was completed near the gravity profile. The 15-km-long line crossed the buried caldera boundary as well as important normal faults. The shot point was located on outcropping basement. Future interpretation of the combined gravity and seismic data should permit the construction of a predictive geophysical model.

37624 **(CONF-8806141—1) US Department of Energy Coordination and Information Center.** (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). 1988. Contract AC08-84NV10327. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88011217/JAW.

From 79. annual conference of the Special Libraries Association; Denver, CO, USA (11 Jun 1988).

The purpose of the Coordination and Information Center (CIC) is to provide information relating to fallout from nuclear weapons tests. The CIC's information collection includes: 1)data and documentation on the detection and measurement of radioactive fallout and related factors resulting from U.S. nuclear tests at the Nevada Test Site, the Trinity test in New Mexico, the Pacific Proving Grounds, and other on-continent test locations; 2)policy documents on conducting nuclear tests and public safety; 3)documents describing the state-of-knowledge of biological effects of radiation; 4)documents on public information, such as AEC news releases, newspaper, magazine, and journal articles; and 5)related scientific and technical studies and reports concerning nuclear tests. Each document in the CIC collection is entered into a bibliographic data base which is searchable by CIC staff members.

37625 **(GAO/RCED—87-134) Nuclear health and safety: Radiation exposures for some cloud-sampling personnel need to be reexamined.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 87p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Between 1945 and 1962, nearly 200,000 Americans participated in the atmospheric nuclear weapons testing program, with more than half receiving some level of radiation exposure. In 1985, a public interest group reported that a radiation monitoring device installed inside aircraft that had penetrated the nuclear clouds read more than twice the level of radiation recorded on film badges worn by the aircraft crews suggesting that a reexamination of radiation exposure should be made. Ground personnel working on the testing program did not consistently wear protective breathing devices when working around radioactive materials.

37626 **(GAO/RCED—88-25BR) Nuclear test lobbying: DOE regulations for contractors need reevaluation.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 45p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Allegations had been made that the Department of Energy was improperly employing contractors to assist in lobbying the Congress on nuclear weapons testing issues. The antilobbying criminal statute has been interpreted by the Department of Justice as allowing federal officials to provide information to the Congress and to state their views on proposed legislation but prohibits "grass-roots" lobbying by federal employees. Thus, DOE's extensive briefings of congressional Members and staff to influence their views on nuclear weapons testing issues did not violate applicable statutory provisions.

37627 **(LA—11226-MS) Roles for neutral particle beams in strategic defense.** Canavan, G.H.; Browne, J. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 122p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010476/JAW.

Neutral particle beams can play a number of unique, critical roles in strategic defense because of their robust mechanism for discrimination and kill. Their operation, status, and applications are evaluated, showing that their near term roles are complementary to kinetic energy weapons. In addition, particle beams are shown to be the primary candidates for interrogating space objects, discriminating numerous light decoys possible in midcourse, and eliminating reentry vehicles among them.

37628 **(LA—11244-MS) Defensive platform size and survivability.** Canavan, Gregory H. (Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 40p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011634/JAW.

This report discusses the survivability of space platforms, concentrating on space based kinetic energy interceptors. It evaluates the efficacy of hardening, maneuver, self-defense, and deception in extending the survivability of platforms of varying sizes to expected threats, concluding that they should be adequate in the near and mid terms.

37629 **(LA—11285-MS) Directed energy architectures.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 58p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010484/JAW.

This report discusses the roles directed energy could play in strategic defense, assesses their likely effectiveness, and outlines the important complementarity between directed and kinetic energy, which appears to be pivotal to the development of robust defenses. Directed energy concepts could provide adequate kill rates that are relatively insensitive to fast, compact launches. Midcourse applications are based on the robust discrimination ability of directed energy weapons.

37630 **(SAND—87-8229) Response of a thin cylindrical shell under lateral impulse loads.** Prantil, V.C. (Sandia National Labs., Livermore, CA (USA)). Mar 1988. Contract AC04-76DR00789. 78p. NTIS, PC A05;3. Order Number DE88008071/JAW.

In support of the current directed energy weapons program investigating lethality levels of short pulse width lasers, a combined analytical/experimental program has been underway to predict large deformation response of conceptual ballistic missile designs to impulsive loading. Both unpressurized cyclindrical shell models have been anaylzed and tested. Such impulsively loaded structures exhibit large scale plastic deformation and local dynamic pulse buckling instability which subsequently influence the loaded surface collapse. Impulse loads were simulated using both lead spray and light initiated high explosive techniques. Finite element calculation using a modified form of the Hughes-Liu shell element verify several characteristics of the structural response observed in experiments. The role of the computational results in identifying lethal impulse levels and response modes is described. In addition, the requirements for initial imperfections and fine mesh discretization for these problems are discussed.

37631 **(SAND—88-0394) Dependence effects in unique signal transmission.** Cooper, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010331/JAW.

"Unique Signals" are communicated from a source to a "strong link" safety device in a weapon by means of one or more digital communication channels. The probability that the expected unique signal pattern could be generated accidentally (e.g., due to an abnormal environment) would be an important measure. A probabilistic assessment of this likelihood is deceptive, because it depends on characteristics of the other traffic on the communication channel. One such characteristic that is frequently neglected in analysis is dependence. This report gives a mathematical model for dependence; cites some of the ways in which dependence can increase the likelihood of inadvertent unique signal pattern generation; and suggests that communicating each unique signal "event" at the highest level of protocol in the communication system minimizes dependence effects. 3 refs., 4 figs.

37632 **(UCRL—53784) Guidelines for evaluating the containment of underground nuclear detonations.** Olsen, C.W. (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 22p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009030/JAW.

Evaluating the containment aspects of an underground nuclear test is a complex, multidisciplinary task. Many factors, manmade and natural, must be considered along with their various interactions. This document lists the factors that should be considered for a complete containment evaluation. It is intended as a guide for the newcomer, a resource for the experienced, and a reminder that we are most often working with imperfect knowledge.

37633 **(UCRL—98429) Designing tomorrow's warheads – today.** Schneider, D.P. (Lawrence Livermore National Lab., CA (USA)). 15 Mar 1988. Contract W-7405-ENG-48. 16p. (CONF-8806110—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008891/JAW.

From Army science conference; West Point, NY, USA (21 Jun 1988).

Until recently, new weapons' warheads were most often an incremental improvement on a previous warhead design. The tools available to the munition designer today, however, allow for a more comprehensive methodology to be employed. The focus of this paper will be a portion of the process of design of an explosively formed projectile (EFP) which uses tantalum as its liner material. Several questions surrounding tantalum's behavior under high strains require answers before such an EFP can be properly designed. The base-technology issues of different material properties will be explored using a three-dimensional finite element code (DYNA3D) and then compared to experiments. State-of-the-art diagnostics are an integral part of this methodology. Predetermined "flasher block" contours will provide specific position/time data which will assist in improving and understanding the high explosive equation of state as well as determining the energy imparted to the liner. In turn, this will lead to improved modeling of the liner as it translates along the line of flight. Flash X-ray Radiograph (FXR) will provide clues to axial symmetry, density, and overall time/distance information. This data will also provide answers to the strain rate depencence of the tantalum. Integration of the data from the experiment with the material response models allows post-experiment normalization of the code. This "normalized" tool is, finally used in the point design of the warhead.

4503 Explosion Detection

37634 **(UCID—21151-Rev.1) Delamar-induced ground motions at the Hardin site.** Hudson, B.; Stubbs, T.; Wheeler, V. (Lawrence Livermore National Lab., CA (USA)). 5 Aug 1987. Contract W-7405-ENG-48. 20p. NTIS, PC A03;3. Order Number DE88009244/JAW.

A satellite hole was drilled near the HARDIN site for the purpose of making hydrodynamics-yield measurements in support of the Treaty Verification Program. The satellite hole was also instrumented for monitoring ground motion from HARDIN. Because there was considerable interest in ground motion at the Hardin site induced by DELAMAR, the HARDIN instrumentation and recording system was activated during the DELAMAR event. This report presents those results. The relationship between DELAMAR and HARDIN is shown in Figures 1 and 2 and in Table 1. The locations of gauges in the HARDIN satellite hole are shown in Figure 3. Table 2 summarizes the peak measured values for ground motion at the HARDIN satellite hole due to DELAMAR, while individual data records are presented in Figures 4-18. Table 2 also includes predicted range of ground motion values. As indicated, the measured peak accelerations are somewhat below the predicted range, while measured peak velocities and displacements are within the predicted range. 18 figs., 2 tabs.

37635 **(UCRL—96747) Planar array bearing estimation performance bounds.** Harris, D.B. (Lawrence Livermore National Lab., CA (USA)). 30 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871162—5). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011313/JAW.

From 21. annual Asilomar conference on signals, systems, and computers; Pacific Grove, CA, USA (2 Nov 1987).

The Weiss-Weinstein bound on bearing estimator mse is evaluated for planar arrays possessing near-circular symmetry and simpler triaxial single-station instruments. The bounds suggest superior bearing estimation performance of small-aperture seismic arrays when contrasted with the simpler instruments, particularly in the threshold SNR region. The results have implications for the composition of a seismic network that might be deployed to verify nuclear test ban treaties. 4 refs., 6 figs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 37093, 37141, 37175

37636 **(LA-UR—88-1238) Update on the meso-microscale meteorological hierarchy.** Williams, M.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 19p. (CONF-8705282—1). NTIS, PC A03;3. Order Number DE88009133/JAW.

From Workshop on mesoscale modelling, turbulence and diffusion; Riso, Denmark (12 May 1987).

SIGTRA is designed to define the height of the material layer and provide interpolated mass and energy fluxes to VARYME. It also provides interpolated winds, temperatures, and potential densities at levels within the material layer. VARTRA uses similarity theory surface energy budget considerations, and the VARYME solutions to perturb the SIGMET profiles. It is the principal vehicle for converting the VARYME solutions into wind and temperature profiles and for incorporating the effects of local heating into the SIGMET solutions. VARTRA also is used to provide input to HRWHER. A number of shortcomings were identified after the early simulations of project WIND measurements in the Sacramento Valley of California. In particular, the surface temperatures were quite different from the measurements and the VARYME solutions were playing a very limited role in the perturbation of the SIGMET solutions. This note describes some of the efforts to cure these problems and the new simulations. The specific case represents the period June 27-28, 1985. The simulations began at 1pm Pacific Standard Time. Results are presented for 3pm on the 27th and 1am and 9am on the 28th. The SIGMET domain is 480 kilometers on a side of which a large portion is apron. Figure 1 reports the terrain of the SIGMET grid. The actual terrain without the apron is shown in Figure 2. 10 refs., 22 figs.

37637 **(LA-UR—88-1328) A radar study of the interaction between lightning and precipitation.** Holden, D.N.; Ulbrich, C.W. (Los Alamos National Lab., NM (USA); Clemson Univ., SC (USA). Dept. of Physics and Astronomy). 1988. Contract W-7405-ENG-48. 10p. (CONF-8806113—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009120/JAW.

From 8. international conference on atmospheric electricity; Uppsala, Sweden (13 Jun 1988).

A radar study was made of the interaction between lightning and precipitation with the 430 MHz Doppler radar at the Arecibo Observatory in Puerto Rico. On one occasion, the spectral power at Doppler velocities near that corresponding to the updraft increased substantially within a fraction of a second after a discharge was detected in the beam. Calculations were made to simulate the effect of an electric field change on mean Doppler velocity for a distribution of droplets in a thunderstorm. 13 refs., 4 figs.

37638 **(PNL-SA—15289) Sensitivity studies from two scavenging models.** Berkowitz, C.M.; Luecken, D.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 14p. (CONF-8708238—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008187/JAW.

From ACID-MODES workshop; Raleigh, NC, USA (4 Aug 1987).

Results from sensitivity studies from two wet deposition models will be presented. One model (the RSM) has been designed for inclusion in the Regional Acid Deposition Model (RADM). The RSM can easily simulate a variety of meteorological and initial chemical conditions, and is therefore suited for a number of sensitivity studies. It has this flexibility as a result of the steady-state assumptions associated with its meteorology. The other model makes use of processor simulations defining detailed, time-dependent cloud simulations, which are then used to drive a version of the PLUVIUS series reactive scavenging model, which incorporates wet removal and aqueous chemistry. The latter approach is less suitable for meteorological sensitivity studies, because of the need to reinitialize the preprocessor simulations. Both models are designed to stimulate aerosol and gas scavenging processes and aqueous chemical reactions within individual storm systems. These models operate on horizontal scales of about 100 {times} 100 km, rather than the 1000-km scales associated with long-range transport or regional-scale air chemistry models. 9 refs., 16 figs.

37639 **(RISO-M—2627) Some properties of the Langevin model for dispersion.** Baas, A.F. de. (Risoe National Lab., Roskilde (Denmark)). Jan 1988. 248p. NTIS (US Sales Only), PC A11/MF A01 . Order Number DE88752925/JAW.

The Langevin equation is used to describe dispersion of pollutants in the atmosphere. The theoretical background for the equation is discussed in length and a review on previous treatments and applications i given. It is shown that the Langevin equation can describe dispersion in complex circumstances. In particular the equation is applied to dispersion in a convective boundary layer, where it reproduced the measurements accurately. Two froms of the Langevin equation, which have both been used in practical applications, are compared and it is concluded that in terms of their theoretical properties, they are not very different in spite of important differences in practical application. 142 refs.

37640 (RISO-M—2630, pp 29-31) **Flash photolysis study of the kinetics of the reaction CH_3COO_2 –> PAN.** Veyret, B.; Bridier, I.; Lesclaux, R. (Laboratoire de Photophysique et Photochimie Moleculaire, Uiversite de Bordeaux, Talence, Cedex (FR)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37641 (RISO-M—2630, pp 32-37) **Concept of life time in molecular collisions and its meaning for theories of ter-molecular reactions.** Nyeland, C. (H.C. Oersted Institute, University of Copenhagen (DK)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37642 (RISO-M—2630, pp 79-83) **Reaction CH_3S + NO_3: mechanism and atmospheric implications.** Barnes, I.; Becker, K.H. (Bergische Universitaet Gesamthochschule Wuppertal (DE)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemi-

cal behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37643 (RISO-M—2630, pp 84-89) **Some reactions of NO_3 with atoms and radicals.** Canosa-Mas, C.E.; Wayne, R.P. (Physical Chemistry Laboratory, Oxford (GB)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37644 (RISO-M—2630, pp 90-95) **Discharge-flow study of NO_3 reactions with free radicals and inorganic molecules.** Poulet, G.; Mellouki, A.; Bras, G. Le. (CNRS - CRCCHT, Orleans (FR)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37645 (RISO-M—2630, pp 128-129) **Spectrokinetic studies of NO_3. Source reactions, selfreactions, and reactions with organic compounds.** Eriksen, K.; Lohse, Ch.; Nielsen. O.J.; Pagsberg, P.; Ratajezak, E.; Sillesen, A. Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37646 (RISO-M—2630, pp 130-132) **Spectrokinetic studies of NO_3 reactions with CH_3 and Cl.** Pagsberg, P.; Ratajczak, E.; Sillesen, A.; Lund, A. (Risoe National Laboratory, Roskilde (DK); University of Linkoeping (SE)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37647 **(RISO-R—548) Puff kinematics.** Kristensen, L.; Kirkegaard, P. (Risoe National Lab., Roskilde (Denmark)). Nov 1987. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752935/JAW.

We have developed a model to predict the growth of a puff in a turbulent fluid. We discuss in some detail basic considerations that lead to a gennerally accepted growth rate equation which requires knowledge of the autocovariance of the puff center velocity to be used. This autocovariance is modelled by an assumption which is similar to Corrsin's (1964) 'independence hypothesis'. We show that our system of equations has only one unknown function, viz. the Eulerian space-time velocity autocovariance, and that it can be solved if we assume that the turbulence is isotropic. The solution differs from that suggested by Mikkelsen et al. (1987) in that the puff growth rate predicted by our model is considerably smaller. We also compare our 'eddy lifetime' with the 'coherence destroying diffusion time' by Comte-Bellot and Corrsin (1970) and conclude that we are compelled by first principles to use the first and not the last of these characterisic time scales in our modelling of a Eulerian single-point autocovariance function and the Lagrangian autocovariance function shows that our model predicts that the first is never less than the last, a result which is in agreement with Kraichnan's (1964) considerations. 21 refs.

37648 **(UCRL—21043) FEM3A: A finite element model for the simulation of gas transport and dispersion: User's manual.** Chan, S.T. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 135p. NTIS, PC E07/MF A01; 1; GPO Dep. Order Number DE88011316/JAW.

Includes 1 sheet of 48x reduction microfiche.

FEM3A is a numerical model that has been developed primarily to simulate the atmospheric dispersion of heavier-than-air gas and liquid releases, using large scientific computers such as a CRAY-1. The model employs a modified Galerkin finite element method to solve the time-dependent conservation equations of mass, momentum, energy, and species of the dispersed material, together with the ideal gas law for the density of the mixture. A generalized anelastic approximation is invoked to preclude sound waves and yet allow large density variations in space and time. Turbulence is parameterized via a K-theory submodel and heat transfer between the ground surface and the vapor cloud is also included. The model can solve both two-dimensional and three-dimensional problems, including treatment of variable terrain and obstructions. It will handle instantaneous sources, finite-duration, and continuous releases. A simple phase-change submodel based on local thermodynamic equilibrium is available for handling the phase transition between vapor and liquid. Over the past six years, the model has been evaluated using a wide range of data obtained from both laboratory-scale and field-scale heavy-gas dispersion experiments. In this report, an overview of the model is given, the theoretical and numerical aspects of the model are briefly described, user's guides for using the model are provided, and three example problems are presented to illustrate the use of the model. 25 refs., 18 figs.

37649 **Comparisons of meteorological structure parameters in complex terrain using optical and acoustical techniques.** Porch, W.M.; Neff, W.D.; King, C.W. (Los Alamos National Laboratory, Earth & Space Sciences Division, Los Alamos, New Mexico 87545). *Applied Optics;* 27: No. 11, 2222-2228(1 Jun 1988).

Remotely sensed wind, temperature changes with height, and turbulence have been compared with in situ instrumentation using optical and acoustic techniques across and within valleys. These comparisons have provided data useful in the interpretation of spatial averages inherent in remote sensing with spatial and temporal representativity of point meteorological measurements in complex terrain. Of particular interest in this study was comparison of the optical turbulence derived index-of-refraction structure function C/sub n/ with the acoustically derived temperature structure function C/sub T/ over divergent scales across and within a valley.

37650 **Analytic spectral functions for atmospheric transmittance calculations.** Green, A.E.S.; Wagner, J.C.; Mann, A. (University of Florida, Gainesville, Florida 32611). *Applied Optics;* 27: No. 11, 2266-2272(1 Jun 1988).

Analytic formulas for the transition energies, intensities, and spectral absorption coefficients of the big (most intense) band systems of H_2O and CO_2 are presented. Analytic spectral representations of the Chappuis band of O_3, three bands of O_3, and two bands of CH_4 are also given. These inputs in conjunction with band model transmission formulas can be used with spectral functions for the extraterrestrial solar irradiance and Rayleigh and aerosol attenuation for engineering-type calculations of the direct solar spectral irradiance reaching the ground between 0.35 and 4.5 μm. Several algorithms may then be used for estimating the diffuse irradiance.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 35599, 35602, 35603, 35612, 35615, 35687, 35688, 35723, 35790, 35855, 35938, 35939, 36154, 36162, 36164, 36576, 36607, 36626, 36656, 36706, 37002, 37091, 37092, 37097, 37098, 37337, 37402, 37419, 37420, 37421, 37638, 37639, 37722, 37726, 37727, 37744, 37748, 37749, 37750, 37751, 37752, 37753, 37754, 37755, 37756, 37808, 37824, 38013, 38042, 38043, 38047, 38067, 38068, 38076, 38080, 38103, 38124, 38125, 38127, 38134, 38139, 38150

37651 **(AD-A—190419/2/XAB) Volatility of aerosols in the western European environment. Interim report No. 1 thru 3.** Jennings, S.G. (University Coll., Galway (Ireland)). Oct 1987. 7p. NTIS, PC A02/MF A01.

The volatility apparatus to be used in the proposed work is being currently assembled at the Atmospheric Sciences Laboratory, White Sands Missile Range, New Mexico. When the volatility apparatus is constructed and tested it will be shipped to University College Galway. It is then planned to carry out field-volatility

measurements of the ambient aerosol, primarily for the unmodified maritime air mass and secondly for the partially modified European continental air mass. Continuous measurements for periods up to some weeks spanning all four seasons are planned. In preparation for these measurements, a digital readout facility was acquired for the IM 146 velocity and direction transmitter to be used for recording wind speed and direction. The measurement system was electronically processed to facilitate continuous recording on a microcomputer.

37652 **(ANL/EES-TM—345-Vol.2) In pursuit of clean air: A data book of problems and strategies at the state level, 1987 update: Volume 2, Federal regions VI through X.** Loughe, A. F.; Gerry, P. A.; Streets, D. G. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 308p. NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88011590/JAW.

This document is the third edition of a report that presents attainment strategies and maps of nonattainment areas throughout the contiguous United States. It contains nonattainment data that are accurate through December 31, 1987. The report presents, by state, tables of nonattainment and maps of areas in nonattainment of standards for total suspended particulates, sulfur dioxide, carbon monoxide, ozone, or nitrogen oxide. A summary of the State Implementation Plans (SIPs), a list of Prevention of Significant Deterioration (PSD) areas, a map of PSD Class I areas, a table of general sulfur dioxide and particulate matter emission limits, and a list of specific power plant emission limits are also presented. 13 refs., 11 tabs.

37653 **(BDX—613-3919) Annual site environmental report for calendar year 1987.** Brown, D.E. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Apr 1988. Contract AC04-76DP00613. 131p. NTIS, PC A07;3. Order Number DE88009364/JAW.

Air, land, and water quality in the Kansas City Plant environment were monitored and results are reported for calendar year 1987. Environmental monitoring for significant non-radioactive pollutants was conducted to allow evaluation of effluent effects on the environs of the federal complex. Monitoring for radioactive pollutants was not conducted because no processes exist that have a radioactive effluent to the environment. The non-radioactive monitoring data were compared to appropriate standards and guidelines. Results of ambient air and surface water analyses are well below standards and demonstrated no discernible adverse effects on air and water quality from plant discharges. On-site ground water monitoring, initially conducted in CY1984, continued in 1987.

37654 **(BNL—40755) Sulfur dioxide-hydrogen peroxide relationships in clean air, clouds, and precipitation.** Schwartz, S.E.; Daum, P.H. (Brookhaven National Lab., Upton, NY (USA)). Jan 1988. Contract AC02-76CH00016. 12p. (CONF-880604—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006352/JAW.

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

In-cloud oxidation by H_2O_2 is a major route for conversion of atmospheric SO_2 to sulfate, as indicated by kinetic calculations for representative H_2O_2 concentrations and supported by the observation of mutual exclusivity of gaseous SO_2 and aqueous H_2O_2 in non-precipitating liquid-water stratiform clouds, which generally persist sufficiently for reaction to proceed to completion. Measurements reported here indicate the aqueous S(IV) and H_2O_2 are also mutually exclusive in surface precipitation samples, but that SO_2 and aqueous H_2O_2 often coexist in precipitating clouds. Gaseous SO_2 and H_2O_2 are also commonly simultaneously present in clear air; in the mixed layer either species maybe in excess, but H_2O_2 present with SO_2 in precipitating clouds is attributed to material dissolved in falling hydrometeors which has not had time to react with SO_2. This supported by model calculations evaluating the characteristic time and distance for reaction of aqueous H_2O_2 in droplets falling through an SO_2-containing layer. 29 refs., 6 figs.

37655 **(CONF-880348—5) Microwave plasma dissociation of hydrogen sulfide.** Harkness, J.B.L.; Gorski, A.J.; Daniels, E.J. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010086/JAW.

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Mar 1988).

The Claus technology and its associated tail gas cleanup (SCOT unit) for hydrogen sulfide environmental control recovers the sulfur contained in hydrogen sulfide wastes but loses the hydrogen as water. The alternative treatment process proposed in this paper uses plasma dissociation to recover the hydrogen in addition to the sulfur, thereby saving a significant fraction of the lost energy. The plasma process also appears to be more economical than the Claus/SCOT process. The total capital required for the plasma facility is projected to be $14 million, versus $26 million (including capital cost for the incremental hydrogen generation capacity) for the Calus/SCOT process. Because of energy savings, the annual operating costs for the plasma process are also lower than for the Claus/SCOT process. Assuming a 15% rate of return on capital, the plasma process will produce a net annual profit of $1.8 million relative to the Claus/SCOT. 4 refs., 6 figs., 3 tabs.

37656 **(CONF-8804140—1) Foliar nitrate reductase: A marker for assimilation of atmospheric nitrogen oxides.** Norby, R.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. (CONF-8804140—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010453/JAW.

From National Research Council workshop on biological markers of air pollution exposure in trees; Little Switzerland, NC, USA (25 Apr 1988).

Atmospheric deposition of nitrates to forest canopies has been implicated as predisposing trees to environmental stresses. A first step in the evaluation of this hypothesis is the determination of whether atmospheric nitrates are absorbed and metabolized by tree foliage. The enzyme nitrate reductase (NR) is an appropriate marker for nitrate metabolism because it is the rate-limiting step in the assimilation of nitrate into organic compounds and it is substrate-inducible. In laboratory studies, NR was not induced in red spruce foliage exposed to NO_3/sup {minus/} in acid mist, but NR activity increased dramatically in spruce seedlings exposed to NO_3 or HNO_3 vapor, suggesting that gaseous nitrogen oxides can be assimilated by spruce foliage. Nitrate reductase activity also can be measured in the field and may be a useful marker for trees that are impacted by nitrogen pollution, but extensive characterization of diurnal and seasonal variation in foliar NR activity is an important prerequisite. 24 refs.

37657 **(CRIE-U—87015) Effect of simulated acid rain on the growth and yield of soybean plants growth in pots.** Kono, Yoshihisa. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Sep 1987. 25p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752545/JAW.

Examination was made on the effect of simulated acid rain on the growth and yield of the soybean plants grown in pots. From the analysis of the rainfalls in Japan, the acid rain used was adjusted to the weight composition ratio of SO_4^{-2} to NO_3^- to CL^- of 2 : 1 : 1, and the four pH levels. The rainfall was 2.2 mm or 5.5 mm for 1 hr. every rain event. The frequency of the rain event was two times a week. The pH of the contrast was 5.6. At a pH of the rain below 4.0, visible symptoms were developed. The dry-weight per plant tended to be larger than that of the contrast at the pH of 4.0, and significantly smaller at the pH of 2.0. The dry seed yield per plant tended to be larger than that of the contrast at the pH of 2.0, and significantly smaller at the pH of 2.0. In this case, reductions in the number of the seeds per pad and in the number of the pads per plant were observed. The growing number of the root modules was larger than that of the contrast at the pH of 4.0 and significantly smaller at a pH below 3.0. (1 fig, 10 tabs, 29 refs)

37658 (DOE/MC/21063—2586) 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized bed gasification system. Quarterly report, October 1-December 31, 1985. (KRW Energy Systems, Inc., Madison, PA (USA)). Mar 1988. Contract AC21-84MC21063. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001091/JAW.

The external hot gas cleanup system, designed for installation on the PDU at Waltz Mill, PA, consists of an external fixed bed desulfurizer of zinc ferrite sorbent, a tertiary particulate removal system (a sintered metal filter and venturi scrubber), and associated piping and instrumentation. The design report for this system was finalized. During the reporting period, PDU structural work was completed and the fixed bed desulfurizer was installed. Candidate samples of zinc ferrite sorbent were procured from United Catalysts, Inc. (2.89/lb) and from AMAX Extractive R & D, Inc. (4.80/lb). These sorbents will be pretested at the US Dept. of Energy Morgantown Energy Technology Center (DOE/METC) before they are tested in the desulfurizer at the PDU. In addition, purchase orders were released for a 5100 lb/hr steam supply system and for components to upgrade the PDU data acquisition system.

37659 (DOE/MC/21063—2587) 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized bed gasification system. Quarterly report, January 1-March 31, 1987. (KRW Energy Systems, Inc., Madison, PA (USA)). May 1988. Contract AC21-84MC21063. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001092/JAW.

Technical progress and accomplishments achieved during external hot gas cleanup (HGCU) testing at the PDU were reviewed with representatives of the US Dept. of Energy Morgantown Energy Technology Center, and a 1987 Program Test Scope was finalized for continuation of PDU tests. The major modification for the next test includes reducing the inside diameter of the external desulfurizer from 4.5 to 2.0 feet which will decrease the bed volume to approximately 18 cubic feet. Thus, the time increment required to achieve sulfur breakthrough of the zinc ferrite desulfurizer bed should be less. Another modification removed the cold wall pipe as a gas cooling and deposit control device at the gasifier exit and added a direct water injection system to cool the product gas. In line with the new test scope, modifications were defined for future tests, such as: the option to test ceramic filter elements in the HGCU filter vessel and the addition of a building on the PDU that will house advanced instrumentation to monitor, record, and characterize the trace contaminants in the hot gas exiting the desulfurizer.

37660 (DOE/NBB—0084) Regional intercomparisons of General Circulation Model predictions and historical climate data: CO_2. Grotch, S.L. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 307p. NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88010416/JAW.

This study is a detailed intercomparsion of the results produced by four different General Circulation Models (GCMs) that have been used to project the climatic consequences of a doubling of the atmospheric CO_2 concentration. The results for the models developed by groups at the National Center for Atmospheric Research (NCARCCM, Washington and Meehl, 1984), the Geophysical Fluid Dynamics Laboratory of NOAA (GFDL, Manable and Wetherald, 1987), and the Goddard Institute for Space Studies of NASA (GISS, Hansen, et al., 1984) have been described by Schlesinger and Mitchell (1985) in the DOE state-of-art (SOA) report, "Projecting the Climatic Effects of Increasing Carbon Dioxide". The fourth model examined here is the Oregon State University GCM (OSU, Schlesinger, 1986), results for which did not become available until after publication of the SOA. We have chosen to examine only two model variables here: (1) surface air temperature, and (2) precipation. We consider these variables for both seasonally and annually averaged periods, for both the current climatic conditions and the predicted equilibrium changes after a doubling of the CO_2 concentration. The major conclusion of this study is that, although the models often agree well comparing seasonal or annual averages over the large areas, substanial disagreements become apparent as the spatial extent is reduced, particularly when detailed regional distributions are examined. At scales below continental, the correlations observed between different model predictions are often very poor, particularly for land gridpoints during the Northern Hemisphere (NH) summer, with differences of as much as 5{degree}C between models and observations and between one model and another over relatively large areas.

37661 (EPRI-CS—5850) Introduction to magnesium-enhanced lime flue gas desulfurization: Videotape workbook. (Electric Power Research Inst., Palo Alto, CA (USA); Radian Corp., Austin, TX (USA)). 1988. 28p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010694/JAW.

This workbook presents an introduction to the chemistry involved in a magnesium-enhanced lime FGD system. It covers the factors affecting the efficiency of magnesium-enhanced lime FGD system operation, emphasizing how an undestanding of the chemistry will help avoid some common problems. The ways in which ion activity and dissolved alkalinity affect sulfur dioxide removal, how relative saturations influence solids formation, and the importance of lime preparation all are explained. This tape is an introduction only; future tapes will cover lime/limestone FGD performance indicators and troubleshooting in more detail.

37662 (EUR—10563) Facts and uncertainties about acid rain a challenge for Europe. Benarie, M. (Commission of the European Communities, Luxembourg). 1986. 51p. Commission of the European Communities, Luxembourg.

This is a review of the topic acidic depositions. It points out the areas of well-established facts and other fields still open to debate and therefore requiring further research. Damages caused by acidic depositions are: - Loss in fish stocks. - Deterioration of stones and structural materials. Neither human health effects, nor crop losses can be clearly linked to acid rain. Acid deposition may be a co-factor of: - Forest damages in Central Europe. No prejudice could be established in Scandinavia. There are areas of future concern: - Soil acidification, and - Surface and ground water quality deterioration. The lack of reliable source-receptor relationships and the insufficiency of trend information does not allow firm opinions. These are other areas for future research. The probable money value of the losses is evaluated. The technical means to curtail emissions are available. Their application would represent about 10 per cent additional expense to the actual energy bills. Some actions of the Commission of the European Communities to safekeep the future and to promote research are discussed.

37663 (EUR—10646) Hydrocarbons Identification of air quality problems in Member States of the European Communities. Bouscaren, R.; Frank, R.; Veldt, C. (Commission of the European Communities, Luxembourg). 1986. 326p. Commission of the European Communities, Luxembourg.

Three European consultants, under contract by the Commission, have studied the problem tied to hydrocarbons in the atmosphere of the European Member States. For the first time, a very detailed emission inventory was made in each country (including Spain and Portugal). These emission inventories confirm that the two main producers of hydrocarbons are solvent consumption and road traffic (approximately 40 % each). A list of substances which are involved in this problem of air pollution (toxicity, chemical reactivity, etc.) has been established with their main characteristics. By enquiring in the Member States, information on the orders of magnitude of hydrocarbon concentrations (total non-methanic or sometimes single species) in the ambient air has been collected. These data show for some substances, and taking into account our present knowledge, the possibility of effects on human health or on ecosystems. Finally a review of the governmental actions already underway confirmed that, probably due to the difficulty of the problem, little coherent effort has been made from the legal point of view; however abatement techniques for hydrocarbon emissions do exist (for stationary sources as well as for mobile sources). But, because of the lack of serious assessments of the problems and of good plant designs, these techniques have often been considered as deceptive and inadequate.

37664 **(GAO/RCED—87-89) Acid rain: Delays and management changes in the federal research program.** (General Accounting Office, Washington, DC (USA)). 1987. 75p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The National Acid Precipitation Assessment Program is to help resolve the scientific uncertainties associated with acid rain and determine if and how it should be controlled. It has yet to issue its first assessment report originally scheduled for release in 1985. NAPAP officials believe that, by 1990, their ongoing research program will provide sufficient new information about the causes and effects of acid rain to serve as the basis for policy recommendations.

37665 **(IVL-B—778-Add.) New findings concerning reactions of airborne Hg in water solutions. Addendum to report IVL-B--778.** Brosset, C. (Swedish Environmental Research Inst., Goeteborg). 18 Mar 1987. 24p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752911/JAW.

It has been observed that airborne metallic Hg-vapour (Hg/sp0/) in the presence of O/sb3/ is oxidized when in contact with acid water solution. The oxidation product Hg/sp2+/ reacts further forming different complexes dependent on other components present in the water solution. When the same type of air as above is introduced into an alcaline water solution containing Hg/sp2+/, the last one will be reduced to Hg/sp0/ which leaves the liquid phase. This reaction does not take place if O/sb3/ is removed from the air, which occurs when the air flow is passing a gold trap before entering the solution. The agent responsible for both the oxidation and the reduction reaction is believed to be H/sb2/O/sb2/ formed from O/sb3/ and H/sb2/O or already present in the air.

37666 **(KFK-PEF—30) Development of a semi-continuous monitor to measure sulfuric acid and total sulfates in clean air regions.** Israel, G.W.; Boehm, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europacisches Forschungszentrum fuer Massnahmen zur Luftre). Jun 1987. 23p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753374/JAW.

An instrument was developed that allows the separate and semi-continuous monitoring of ambient sulfuric acid and sulfates. The sulfate concentration is measured continuously with a flame photometric detector. The sulfuric acid is first absorbed and accumulated in a thermodiffusion denuder and subsequently analysed by the same detector. With a time resolution of 30 min. the detection limit of the instrument amounts to 1.0 μmm^3 for sulfate and 0.1 μgm^3 for the sulfuric acid. The automated and micro-computer controlled instrument is designed for use in forests. With 8 figs., 16 refs..

37667 **(LBL—24219) Removal of NO/sub x/ and SO_2 from flue gas using oxidizing compounds.** Littlejohn, D.; Chang, S.G. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 23p. (CONF-880604—12). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011958/JAW.

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

There are several general methods of NO/sub x/ and SO_2 from flue gas using chemical reactions. The pollutants can be oxidized, reduced, complexed or dissolved. Oxidation of NO/sub x/ and SO_2 will ultimately yieid nitrate (NO_3^-) and sulfate (SO_4^{2-}) when in solution. Reduction will lead to N_2 and elemental sulfur. Complexation has generally been applied to NO/sub x/ to generate nitrosyl complexes. Since NO/sub x/ is not highly soluble in aqueous solution, dissolution has been generally applied to SO_2 to generate HSO_3^- and SO_3^{2-}. It is desirable to develop a single process which acts on both SO_2 and NO/sub x/ to minimize the complexity of the scrubbing system for the power plant. A suitable oxidizing or reducing system could meet this criterion. The authors have investigated several peroxy compounds to determine their usefulness in removing NO/sub x/ and SO_2 from flue gas by oxidation.

37668 **(LBL—24891) Real-time measurements of the size fractionation of ambient black carbon aerosols at elevated humidities.** Hansen, A.D.A.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 12p. (CONF-871055—7). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010870/JAW.

From 3. international conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (5 Oct 1987).

The aethalometer is an instrument that responds to the concentration of aerosol black carbon in real time. Recent versions constructed at Lawerence Berkeley Laboratory (LBL) contain two or three channels that may be operated simultaneously. When preceded by size-segregating inlets of differing cut points, this configuration allows for a real-time determination of the size fractionation of the black carbon component of the aerosol. In field measuremens at LBL, we studied the incorporation of black carbon into marine fog droplets by comparing the total concentration with the "interstitial aerosol" concentration measured downstream of an interception mesh of 1-μm cutpoint. The data show that up to 80% of the carbon may be occluded by dropplets. In separate experiments during SCAQS program in southern California, a three-channel instrument, equipped with impactors, measured total, <1 μm, and <0.03 μm concentrations, and showed duirnal variations of size fractionation of the ambient carnonaceous aerosol. These results imply that a significant fraction of the aerosol black carbon particles may exhibit hygroscopic behavior. 6 refs., 3 figs.

37669 **(LBL—24892) A concurrent-flow cloud chamber study of incorporation of black carbon into droplets.** Benner, W.H.; Hansen, A.D.A.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 18p. (CONF-871055—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010858/JAW.

From 3. international conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (5 Oct 1987).

A concurrent-flow cloud chamber (16 cm i.d., 1.5 m high) is described in which cold particle-free and humidified particle-laden air streams were mixed to condense water droplets onto combustion-generated soot particles. Total and interstitial black carbon (BC) concentrations in the cloud were measured as a function of input black carbon concentration and the sample air stream dew point in real time, using a two-channel aethalometer. For black carbon particles produced by the combustion of propane, as much as 90% (by mass) of the black carbon when [BC] < 5 $\mu g/m^3$ was incorporated; this decreased to {approxiametly}20% when [BC] $>$ 20 $\mu g/m^3$. It was observed that as sample dew point passed through a maximum, simultaneous maxima were observed in the fraction of black carbon incorporated into droplets and in the amount of black carbon associated with large droplets that settled out of the air stream. The effective supersaturation in the chamber is a function of particle concentration. For black carbon particle concentrations above {approximately}20 $\mu g/m^3$, the estimated supersaturation is of the order of several percent for the experimental conmditions used. 10 refs., 6 figs.

37670 **(LBL—25034) Real-time measurement of aerosol black carbon during the carbonaceous species methods comparison study.** Hansen, A.D.A.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 15p. (CONF-871055—1; CONF-871055—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010779/JAW.

From 3. international conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (5 Oct 1987).

During the Carbonaceous Species Methods Comparison Study, we used the aethalometer, an instrument developed at LBL that measures the concentration of aerosol black carbon ([BC]) in real time. Measurements were taken from August 12-21, 1986, with a 1-min time base and grouped to show 1-hr and multihour concentrations. We found concentrations generally ranging from 1 to 10 $\mu g[BC]m^3$, usually increasing in the morning hours. We also observed short-duration (2--15 min) peaks in the black carbon concentration that could be directly attributed to the activity of vehicles in a delivery area less than 50m from the study site. We conclude that mobile sources were the major contributor to the short- and

medium-term variability of aerosol black carbon measured at this site. 7 refs., 4 figs.

37671 **(MST-LUFT-A—118) SO2-air quality evaluation by means of OML model for Esjberg, Odense and Aalborg.** Loefstroem, P.; Gislason, K.B.; Berkowicz, R. (Miljoestyrelsen, Roskilde (Denmark). Luftforureningslab.). Nov 1987. 87p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753329/JAW.

The Danish National Agency of Environmental Protection has in collaboration with local and regional authorities conducted a nationwide Air Quality Evaluation Program (abbreviated to LMP in Danish) for seven Danish cities. These are Copenhagen, Naestved, Odense, Fredericia, Randers, Esbjerg and Aalborg, with populations ranging from 30,000 to 1.000,000. The purpose of the program was fourfold: To gain knowledge on air quality in selected Danish cities, to test meteorological air quality models, to monitor the development of the air quality, and to form the initial basis for a mapping of the air quality in Denmark. In each of the seven cities several monitors were set up to measure SO2 (and other gases). Further, a mapping was undertaken of SO2-emissions from larger Point Sources, and from smaller sources grouped together in Area Sources (500 x 500 m2). The emissions from this mapping have been used in model calculations for the cities. The OML-model, which is a Gaussian model developed at the Danish Air Pollution Laboratory of the Danish EPA, was applied. Calculations were performed for every hour over a two-year period. Mean values and percentiles of SO2- concentrations were determined. Calculations of SO2-concentrations for Esbjerg, Odense and Aalborg are presented. A major result is that in all cities a few "large" sources (i.e. either source with large emission or sources where the plume is under influence of the wake from surrounding buildings) dominate the SO2-levels for short time periods. Small and large sources are important for long time periods. On the applied scale of resolution (250 m) the calculations show that the levels of SO2-concentrations and their geographical distribution do not vary considerably from one year to another. 20 refs.

37672 **(MST-LUFT-A—119) SO2-air quality evaluation by means of OML model for Randers, Fredericia and Naestved.** Loefstroem, P.; Stenfalk, L.; Berkowicz, R. (Miljoestyrelsen, Roskilde (Denmark). Luftforureningslab.). Nov 1987. 77p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753330/JAW.

The Danish National Agency of Environmental Protection has in collaboration with local and regional authorities conducted a nationwide Air Quality Evaluation Program (abbreviated to LMP in Danish) for seven Danish cities. These are Copenhagen, Naestved, Odense, Fredericia, Randers, Esbjerg and Aalborg, with populations ranging from 30,000 to 1.000,000. The purpose of the program was fourfold: To gain knowledge on the air quality in selected Danish cities, to test meteorological air quality models, to monitor the development of the air quality, and to form the initial basis for a mapping of air quality in Denmark. In each of the seven cities several monitors were set up to measure SO2 (and other gases). Further, a mapping was undertaken of SO2-emissions from larger Point Sources, and from smaller sourses grouped together in Area Sources (500 x 500 m2). The emissions from this mapping have been used in model calculations for the cities. The OML-model, which is a Gaussian model developed at the Danish Air Pollution Laboratory of the Danish EPA, was applied. Calculations were performed for every hour over a two-year period. Mean values and percentiles of SO2-concentrations were determined. Calculations of SO2-concentrations for Randers, Fredericia and Naestved are presented. A major result is that in all cities a few "large" sources (i.e. either source with large emission or sources where the plume is under influence of the wake from surrounding buildings) dominate the SO2-levels for short time periods. Small and large sources are important for long time periods. On the applied scale of resolution (250 M) the calculations show that the levels of SO2-concentrations and their geographical distribution do not vary considerably from one year to another. 13 refs.

37673 **(MST-LUFT-A—120) Summary of the essential results in a national air quality measuring program.** Palmgren Jensen, F. (Miljoestyrelsen, Roskilde (Denmark). Luftforureningslab.). Oct 1987. 28p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752914/JAW.

The Danish Air Quality Monitoring Programme has been carried out in the period 1980-86 as a cooperation between the National Agency of Environmental Protection, the Greater Copenhagen Council, counties and municipalities in 7 urban areas. The monitoring includes SO2, and TSP (total suspended particulates) measurements at 30 locations. In addition, detailed emission inventories and meteorological air quality model calculations were performed for SO2. The following main conclusions about the air quality in Danish urban areas could be made: 1) Measured and calculated concentrations of SO2 in the 6 provincial towns showed no exceedings of limit values. Also the measured concentrations of SO2 in Copenhagen showed no exceedings of limit values. 2) In the provincial towns the model calculations showed exceedings of guide values of 99-percentiles of 1 hour average around single sources. 5) Annual averages of SO2 in the provincial towns were typically determined of all point sources. Building effects gave locally high values. Area sources did only contribute a little to the annual averages. Long-range transport did only contribute a little to the annual averages (6-9 mug/m3). (EG).

37674 **(NILU-OR—22/87) Oxidant data collection in OECD-Europe 1985-1987 (oxidate). Report on ozone, nitrogen dioxide and peroxyacetyl nitrate, April-September 1985.** Grennfelt, P.; Saltbones, J.; Schjoldager, J. (Norsk Inst. for Luftforskning, Lillestroem). Apr 1987. 103p. NTIS (US Sales Only), PC A06. Order Number DE88752843/JAW.

The report deals with a joint project of European OECD countries for the collection and distribution of regional data on ozone, nitrogen dioxide, and peroxyacetyl nitrate (PAN). The individual countries have selected a number of 25 monitoring stations, and they have been responsible for the quality assurance of the data. There has been no centrally organized intercalibration or other data control activity. The measuring methods used are chemiluminescence or UV absorption for ozone, chemiluminescence for nitrogen dioxide, and gas chromatography with electron capture detection for PAN. Ozone was reported from 24 stations, nitrogen dioxide from six, and PAN from one station. The ozone data have indicated a gradient in episodic high consentrations with lower levels in the north-western part, and higher levels towards the central and south-eastern part of Europe. It is not clear whether this is a general result or representative for 1985 only. There is a need to include more countries and monitoring stations in the project in order to improve the understanding of the oxidant phenomenon. 15 drawings, 10 tables.

37675 **(NILU-OR—45/85) Environmental impact of methanol as motor vehicle fuel.** Wathne, B.M.; Hov, Oe. (Norsk Inst. for Luftforskning, Lillestroem). Sep 1985. 117p. NTIS (US Sales Only), PC A06. Order Number DE88752844/JAW.

Methanol and gasoline/methanol blends are possible automobile fuels. Aldehyde and unburned methanol content in exhaust gases will increase with increasing use of methanol. NO(x) will decrease. Methanol can reduce the need for lead additives in gasoline. Formaldehyde is the dominant aldehyde in exhaust gases and in the atmosphere. Air quality standards, measured values and emission factors are listed. Health effects, atmospheric formation and degradation have been described. Calculations have been made which show that the addition of methanol to gasoline will result in slightly lowered photochemical activity. 166 refs., 30 figs., 24 tabs.

37676 **(ORNL—6441) Environmental Sciences Division annual progress report for period ending September 30, 1987.** (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 221p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88010764/JAW.

Environmental Sciences Division Publication No. 3092.

This progress report summarizes the research and development activities conducted in the Environmental Science Division of

Oak Ridge National Laboratory during the period October 1, 1986 through September 30, 1987. The report is structured to provide descriptions of current activities and accomplishments in each of the Division's major organizational units. Following the accounts of section activities and program activities is a section devoted to lists of information necessary to convey the scope of the work in the Division.

37677 **(PB—88-180393/XAB) Removal of volatile aliphatic hydrocarbons in a soil bioreactor.** Kampbell, D.H.; Wilson, J.T.; Read, H.W.; Stocksdale, T.T. (Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab.). 1987. 7p. (EPA—600/J-87/261). NTIS, PC A02/MF A01.

Pub. in International Jnl. of Air Pollution Control and Hazardous Waste Management, Vol. 37, No. 10, 1236-1240(Oct 1987).

Soil removal of propane, isobutane and n-butane from a waste air stream was evaluated in the laboratory and in a prototype soil bioreactor. Laboratory investigations indicated first-order kinetics and the potential to degrade light aliphatic hydrocarbons and trichlorethylene, a compound ordinarily resistant to aerobic biological treatment. The predicted behavior of the bioreactor, based on laboratory studies, agreed closely with the actual behavior of the field system. The prototype bioreactor reduced the hydrocarbon concentrations in the air by at least 90% with a residence time of 15 minutes and a pressure drop of 85 cm of water. The bioreactor functioned well through a range of temperatures, 12C to 24C.

37678 **(PB—88-181052/XAB) Model and data-base description for California's Level 1 PM(10) assessment package. Final report, 15 July 1985-30 April 1987.** Watson, J.G.; Chow, J.C.; Freeman, D.L.; Egami, R.T.; Roberts, P.T. (Nevada Univ., Reno (USA). Desert Research Inst.). Sep 1987. 170p. (DRI—8066-002.1F1). NTIS, PC A08/MF A01.

See also PB—88-181060.

A Level I PM(10) Assessment Package described will allow initial estimates to be made of the source contributions to PM(10) receptor concentrations. The package consists of the Principal Components Analysis, Chemical Mass Balance (CMB), and Industrial Source Complex-Short Term models implemented on IBM/PC compatible microcomputers. The software is applicable to existing data sets and is consistent with EPA's protocols for application and validation of the CMB receptor model and for reconciling differences among receptor and dispersion models. The document describes the models included in the Level I PM(10) Assessment Package, the measurement methods which are commonly applied to obtain model input data, and the availability of these data in the state of California. A companion users' manual provides step-by-step instructions on the application of the package to real data.

37679 **(PB—88-181060/XAB) Model and data-base description for California's Level 1 PM(10) assessment package: users' guide. Final report, 15 July 1985-30 April 1987.** Freeman, D.L.; Robinson, N.F.; Watson, J.G.; Chow, J.C.; Egami, R.T. (Nevada Univ., Reno (USA). Desert Research Inst.). Oct 1987. 125p. (DRI—8066.2F). NTIS, PC A06/MF A01.

See also PB—88-181052.

A Level I PM(10) Assessment Package described will allow initial estimates to be made of the source contributions to PM(10) receptor concentrations. The package consists of the Principal Components Analysis, Chemical Mass Balance, and Industrial Source Complex-Short Term models implemented on IBM/PC compatible microcomputers. The software is applicable to existing data sets and is consistent with EPA's protocols for application and validation of the CMB receptor model and for reconciling differences among receptor and dispersion models. The document describes the models which are included in the Level I PM(10) Assessment Package, the measurement methods commonly applied to obtain model input data, and the availability of these data in the state of California. A companion users' manual provides step-by-step instructions on the application of the package to real data.

37680 **(PB—88-181805/XAB) Implications of perception thresholds for soiling.** Bradow, F.V.; Lockheed, G.R.; Bradow, R.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Mar 1988. 25p. (EPA—600/D-88/044). NTIS, PC A03/MF A01.

Soiling of materials and visibility reduction are the two most-important welfare effects of particulate matter. Though the relationship between fine particles and visibility reduction is well documented, the evidence for the relationship of ambient particles to soiling is scant and poorly understood. Considerable uncertainty exists concerning the amount of surface-accumulated particulate matter that leads to a decision to clean, since not only are socio-economic factors involved in such a decision, but accumulation of the particles must first be perceived as soiling. Information regarding relevant physical and chemical properties of airborne particles are reviewed (e.g., factors affecting deposition velocity and color). Considerations to assure congruency between physical-measurement techniques and human observations are discussed. Factors are recommended for inclusion in development of psychophysical models to relate psychological and physical scales of soiling.

37681 **(PB—88-184429/XAB) CO_2-problems. Scientific insights and social consequences.** (Gezondheidsraad, The Hague (Netherlands)). 16 Dec 1986. 149p. (In Dutch). (R—32). NTIS, PC E06/MF A01.

The second report on the effects of increasing CO_2 concentration in the atmosphere was prepared by a committee of the Health Council of the Netherlands. The committee focused its considerations on the possible impacts on society. The increase of CO_2 concentration in the atmosphere is continuing at approximately a rate of 0.5% per year, notwithstanding the somewhat reduced rate of increase of fossil fuel consumption since 1980. The CO_2 increase itself is not directly harmful for human beings, but climate changes and other indirect consequences may seriously affect their wellbeing. The committee arrived at a number of conclusions: within 50 years from now expected changes call for measures to be taken in the field of coastal protection and water management; at longer time scales, climate changes and the CO_2 stimulating effect on plant growth call for measures in the field of agriculture, food supply and the management of natural ecosystems.

37682 **(PB—88-185640/XAB) Observations on studies useful to asbestos O and M activities. Technical paper.** Wilmoth, R.C.; Powers, T.J.; Millette, J.R. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Mar 1988. 28p. NTIS, PC A03/MF A01.

Buildings that contain ACM (asbestos-containing-materials) may present unique problems for custodial workers. The release of asbestos by aging and deteriorated ACM is known to be episodic, relating to a myriad of factors such as activity within the area, vibration, temperature, humidity, airflow, use patterns, etc. Hopefully, for the majority of buildings containing ACM, fiber release is minimal. If a building contains asbestos and releases occur, the custodial worker may be most intensely affected over the long term. If a release occurs, much of the asbestos will eventually settle and attach to the surfaces of the rooms (walls, furnishings, equipment, floors, and carpet). The preliminary analysis of dusty environments is presented for the micro-vac, sonification, and passive-air-current sampling methodologies.

37683 **(PB—88-186317/XAB) Mesoscale modeling of acid deposition in Maryland. Final report.** Kumar, S. (Versar, Inc., Columbia, MD (USA)). Oct 1987. 167p. NTIS, PC A08/MF A01.

See also PB—88-157805 and PB—88-186309.

The MESOPUFF-II model was exercised to examine spatial and temporal patterns of wet acid deposition in Maryland due to major in-state sources. An entire year (1984) of meteorological data was used as input to the model. Isopleths of predicted monthly and annual wet deposition over Maryland are presented, based on a total of 111 receptors modeled including estimates of wet deposition for 11 monitoring sites in and around Maryland. Two source scenarios of interest were investigated, namely, major power plant

sources in Maryland and the Baltimore Metropolitan Area source. The results of modeling showed that for the case of elevated point sources, representing major Maryland power plants, wet deposition of primary species (SO_3) tends to occur locally around the sources, while wet deposition of secondary species (SO_4, NO_3, and HNO_3) peaks at distances of 75-100 km from the largest sources.

37684 **(PB—88-186655/XAB) Formaldehyde: a candidate toxic air contaminant. Final report.** Frye, B.; Parker, T. (California State Air Resources Board, Sacramento (USA)). Mar 1988. 14p. (ARB/SS—88/02). NTIS, PC A03/MF A01.

Formaldehyde (HCHO) is a gas widely used in adhesives and resins, textiles, embalming fluids, fungicides, air fresheners, and cosmetics. It is directly emitted into the ambient outdoor air from vehicular and stationary sources, and is also produced in the atmosphere from other substances by photochemical smog processes. The International Agency for Research on Cancer (IARC) has determined that there is sufficient evidence for carcinogenicity of formaldehyde to animals, and limited evidence for carcinogenicity to humans. EPA classifies formaldehyde as a probable human carcinogen with a one in a million risk concentration of 0.08 ppb.

37685 **(PB—88-186911/XAB) Facts and uncertainties about acid rain: a challenge for Europe. Final report.** Benarie, M. (Commission of the European Communities, Luxembourg). 1986. 58p. (EUR—10563-EN). NTIS, PC E04/MF E04.

Customers in the European Community countries should apply to the Office for Official Publications of the European Communities, B.P. 2985, Luxembourg.

The report reviews the topic acidic depositions. It points out the areas of well-establibhed facts and other fields still open to debate and therefore requiring further research. (1) Damages caused by acidic depositions are: Loss in fish stocks. Deterioration of stones and structural materials. Neither human health effects, nor crop losses can be clearly linked to acid rain. (2) Acid deposition may be a co-factor of: Forest damages in Central Europe. (3) There areas of future concern are: Soil acidification, and Surface and ground water quality deterioration. The probable money value of the losses is evaluated. The technical means to curtail emissions are available. Their application would represent about 10% additional expense to the actual energy bills. Some actions of the Commission of the European Communities to safekeep the future and to promote research are discussed.

37686 **(PB—88-190632/XAB) Formation and control of nitrogen-containing air pollutants. Final report, June 1983-April 1987.** Russell, A.G.; Cass, G.R. (California Inst. of Tech., Pasadena (USA). Environmental Quality Lab.). May 1987. 229p. (EQL—24). NTIS, PC A11/MF A01.

This work focuses on the formation, transport, and control of nitrogen-containing air pollutants. Particular attention is paid to the problem of understanding how to control atmospheric-aerosol nitrate and nitric acid concentrations. In the course of the study, additional insights are gained into the effects of emission controls on other co-pollutants, including NO_2, O_3, PAN and ammonia. Computer-based theoretical models are employed that relate emissions of reactive organic gases, oxides of nitrogen and ammonia to downwind pollutant concentrations. Both trajectory models that follow the path of a single air parcel and grid models that examine an entire air basin are used. The trajectory version of the atmospheric model is used extensively to test the new features of the chemical mechanism that is built into these models. Nighttime atmospheric chemical reactions that can lead to nitric acid formation are examined, and are found to produce significant amounts of HNO_3. The hypothesis that atmospheric HNO_3 and NH_3 are in equilibrium with the aerosol phase is tested, and found to be a useful basis for predicting the ambient HNO_3 and NH_3 levels.

37687 **(PB—88-191374/XAB) Parametric methodologies of cloud vertical transport for acid-deposition models.** Vukovich, F.M.; Haws, R.C. (Research Triangle Inst., Research Triangle Park, NC (USA)). Mar 1988. 309p. NTIS, PC A14/MF A01.

A CUmulus VENTing (CUVENT) cloud module has been developed that calculates the vertical flux of mass from the boundary layer to the cloud layer by an ensemble of nonprecipitating subgrid-scale air-mass clouds. This model will be integrated into the Regional Acid Deposition Model (RADM) and will serve to establish the effect of cloud venting for the RADM. In the initial phase of this research project, the basic cloud venting algorithm was established. CUVENT used the cloud model that was established by Ritter and Stedman (1985) to calculate the vertical transport of mass due to the ensemble of nonprecipitating air-mass convective clouds. The major effort of the first phase of this research project was to design an optimal parameterization scheme for the cloud model so that it may be incorporated in the RADM. This parameterization scheme used basic meteorological data such as pressure, temperature, humidity, surface heat flux, etc., to predict the convective cloud amount at cloud base and cloud distribution parameters. The various models that made up this scheme were developed using data obtained during the VENTEX field program.

37688 **(PB—88-193628/XAB) Theoretical studies of long-range transport of oxidants. Final report.** Sillman, S.; Jacob, D.J.; Logan, J.A.; Spivakovsky, C.M.; Yevich, R.M. (Harvard Univ., Cambridge, MA (USA)). 29 Dec 1987. 98p. NTIS, PC A05/MF A01.

See also report dated Mar 86, PB—86-232683.

The goal of the project was to develop a model with the capabilities of predicting ozone levels in rural areas. The focus was on long-term statistical measures of air quality. The effort was undertaken in concert with projects funded by NASA and NSF in which a large-scale 3-dimensional chemical tracer model (CTM) was developed for the purposes of studying global atmospheric processes. An ab initio general circulation model (GCM) provides the dynamical framework for the CTM. The CRC project was intended to bring the global model to the regional scale, allowing simulation of mechanisms for production of rural ozone in a realistic dynamical framework. The report details results from four studies which were used to rigorously test the concepts to be employed in the fully coupled CTM. It was shown that the concentrations of ozone precursors in rural air are sufficient to produce significant levels of photochemical oxidant in 1-3 days. Thus, under stagnation conditions, rural ozone levels will become elevated due to local photochemistry.

37689 **(PB—88-195177/XAB) Impact on ozone attainment of CFC (chlorofluorocarbon) controls used to prevent future depletion of stratospheric ozone.** Harmon, D.L.; Smith, N.D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Apr 1988. 19p. (EPA—600/D-88/074). NTIS, PC A03/MF A01.

This paper discusses the impact on ozone attainment of chlorofluorocarbon (CFC) controls used to prevent future depletion of stratospheric ozone. It has been decided that allocated quotas offer the most-attractive approach to limiting the use of CFCs and brominated compounds (halons). This approach should provide for economically efficient reductions. It involves a minimum of administrative costs, is the most easily enforced option, and does not raise any potential legal issues that might result from other options. Control options that might be used by industry to achieve the necessary CFC reductions are evaluated in the Regulatory Impact Analysis (RIA). The most likely long-term control option which may be adopted by most application areas is a chemical substitute. With this option, it may be possible to eliminate 90% or more of the ozone-depleting CFC emissions. A variety of control options hold promise for short-term applicability. Some of the engineering controls may still be applied even after new chemical substitutes (e.g., HFC-134a and HCFC-123) are in use, since the higher cost of these substitutes may justify recovery. EPA is also considering the development of specific regulations limiting CFC and halon use for particular industries to supplement allocated quotas.

37690 **(PNL—6461) The MAP3S network data and quality control summary for 1985.** Dana, M.T. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 84p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008463/JAW.

This report, the ninth in a series documenting results from the MAP3S Precipitation Chemistry Network, contains a statistical

summary of daily precipitation chemistry data from the nine-site network in the eastern United States, both for the year 1985 alone and for the period 1977 through 1985. In addition, a report on quality control and external quality assurance activities is included, which updates the 1980 quality control report.

37691 **(PNL-SA—15645) Statistical techniques for regional model evaluation.** Dana, M.T. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 9p. (CONF-880388—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008206/JAW.

From NAPAP atmospheric chemistry task group II peer review; Oxford, OH, USA (16 Mar 1988).

Regional acidic deposition models, such as RADM, can generate both short-term and long-term average concentration and deposition fields for the chemistry of precipitation. Evaluation of these averages at sampling points has difficulties: low spatial grid resolution makes the test for short-term (e.g., precipitation event) averages too severe, while the predicted long-term (e.g., annual) averages can too easily approximate measurements without properly addressing mechanisms. These models, however, should be able to simulate concentration distributions at sampling points and reflect seasonal and spatial variations caused by physical and chemical processes included in the models. The availability of 10 years of regional event precipitation chemistry data makes it possible to produce robust distributions of observations for the modeling community's use in evaluation and further development. The project objectives are to calculate and characterize precipitation concentration distributions for sampling sites in the MAP3S network (eastern United States) region; and to evaluate the distributions in terms of spatial, seasonal, and chemical species variations, with the aim of simplifying the model evaluation process. 1 ref., 5 figs., 2 tabs.

37692 **(PNL-SA—15687) Large-eddy simulations of concentration fluctuations.** Bader, D.C.; Horst, T.W. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 4p. (CONF-880463—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009480/JAW.

From 8. symposium on turbulence and diffusion of the American Meterological Society; San Diego, CA, USA (1 Apr 1988).

This paper describes an initial effort to develop a model for numerical simulation of atmospheric diffusion that has spatial and temporal resolution adequate for the estimation of concentration fluctuation statistics. Our intention is to develop a research model whose output has the realism necessary for development and testing of simpler models and parameterizations of concentration fluctuation statistics, which can in turn be used to solve applied problems. This model is built on a large-eddy simulation (LES) model of the turbulent flow field and a time-dependent solution of a passive tracer conservation equation, with a turbulence closure that parallels the LES closure of the Navier-Stokes equations. The model is used to simulate the neutral boundary layer wind-tunnel experiments of Fackrell and Robbins (1982) and the results are evaluated against their measurements. It is believed that once the model can faithfully reproduce observed data, it can then be used as an experimental tool to produce realistic simulations of new and currently unobserved cases. 8 refs., 2 fis.

37693 **(PNL-SA—15689) Field-study design for module evaluation: PRECP VI/3CPO.** Hales, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 8p. (CONF-880351—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008183/JAW.

From NAPAP atmospheric chemistry task group review; Knoxville, TN, USA (13 Mar 1988).

PRECP VI is the sixth in a progressive series of scavenging field studies, and is centered on the analysis of scavenging by summertime convective storms in polluted environments. Such storms are of substantial interest to NAPAP because they account for a large fraction of the pollution that is wet-deposited annually in the eastern half of the country. Accordingly, convective-storm scavenging behavior must be understood quantitatively to evaluate issues such as nonlinearity and the effects of emission changes on wet deposition. The Regional Acid Deposition Model (RADM) contains a convective-storm scavenging module that has been developed as a component of the NAPAP program. Although this module has been designed to simulate actual scavenging phenomena as accurately as is possible within the constraints imposed by RADM's architecture, to date there has been no satisfactory evaluation of this module's performance in light of a comprehensive data set. One of the important roles of PRECP VI is the generation of a robust data base to be used for this purpose. 1 ref., 2 figs.

37694 **(PNL-SA—15768) Computer simulation procedure for designing airborne aerometric monitoring programs.** Hales, J.M.; Pennell, W.T. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 3p. (CONF-8805101—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011896/JAW.

From Conference on lower troposphere profiling: needs and technologies; Boulder, CO, USA (31 May 1988).

With the growing cost and sophistication of modern meteorological and air pollution field experiments, it is becoming increasingly necessary to improve the quality of the design phase of these programs. Experiment designers are faced with the difficult task of choosing, from an ever-expanding assortment of choices, the optimum mix of fixed and mobile, in situ- and remote-sensing devices needed to meet the measurement objectives of their programs. Choosing this optimum mix also requires the designer to determine how these sensing devices should be deployed - given some hypothesis about the spatial and temporal structure of the fields to be observed. The demands of this design process suggest the need for objective analysis tools that allow a designer to examine quantitatively the operational behavior of various measurements techniques and measurements platforms and to assess the effectiveness of alternative sampling strategies.

37695 **(PNL-SA—15880) Effect of the ASARCO smelter shutdown on the acidity of rainfall in the Puget sound area.** Laulainen, N.S.; Larson, T.V.; Vong, R.J.; Zoller, W.H. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 12p. (CONF-880595—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011898/JAW.

From NAPAP atmospheric transport and modeling research program review meeting; Richmond, VA, USA (1 May 1988).

The influence of the sulfur dioxide emissions from a large copper smelter in Tacoma, Washington, USA, was studied by measuring the chemical composition of rainwater collected upwind and downwind of the source, before and after permanent closure of the smelter in 1985. Data analysis was based on a statistical model that accounted for variability associated with location of 25 sampling sites within three geographic regions, smelter operation, ten individual rain events observed over 2 years, and measurement uncertainty. After smelter closure, the upwind-downwind differences in mean hydrogen ion and excess sulfate ion concentrations within a 600 km^2 region extending to 25 km downwind of the source had decreased significantly compared to the pre-closure value. No significant decreases in mean ion concentrations were observed farther downwind in the Seattle, urban area. During five events sampled prior to smelter closure, we estimate that an average of 1.7% (range 0.3 to 3.0%) of the sulfur dioxide emitted by the smelter was wet deposited as sulfate ion within a 3600 km^2 area extending 60 km downwind of the source.

37696 **(RISO-M—2630) Tropospheric NO/sub x/ chemistry - gas phase and multiphase aspects.** Nielsen, O.J.; Cox, R.A. (eds.). (Risoe National Lab., Roskilde (Denmark)). Jan 1988. 154p. (CONF-8709266—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW.

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

Proceedings of the 6th workshop organised within the framework of the Working Party 2 "Chemical and Photochemical Reactions" of the Concerted Action "Physico-Chemical Behaviour of Atmospheric Pollutants" held at Risoe National Laboratory, Roskilde, 17.-18. September 1987. 115 refs. 20 tabs.

37697 (RISO-M—2630, pp 9-10) **Calculation of the distribution of NO/sub x/ compounds in Europe.** Hov, Oe.; Eliassen, A.; Simpson, D. (NILU, Lillestroem (NO); The Norwegian Meteorological Institute, Blindern, Oslo (NO); Warren Spring Laboratory, Stevenage, Hertfordshire (GB)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37698 (RISO-M—2630, pp 41-43) **Effect of adsorbent media on the oxidative loss of acenaphthene, fluorene and anthracene by exposure to NO_2, SO:2 ad O_3.** Lindskog, A.; Brorstroem-Lunden, E.; Iverfeldt, Aa. (Swedish Environmental Research Institute, Goeteborg (SE)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37699 (RISO-M—2630, pp 44-49) **Application of salmonella tests for studying atmospheric reactions of particle associated PAH.** Ostenfeldt, N. (Institute of Toxicology, Danish National Food Agency, Soeborg (DK)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37700 (RISO-M—2630, pp 50-60) **Jet reactor to study trace gas transfer across the air/liquid interface.** Kirchner, W.; Schurath, U. (Institut fuer Physikalische Chemie der Universitaet, Bonn (DE)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37701 (RISO-M—2630, pp 61-67) **Study of the reaction between nitrogen oxides and water vapour by means of annular denuder tubes.** Febo, A.; Santis, F. De; Perrino, C.; Liberti, A. (Istituto sull'Inquinamento Atmosferico del C.N.R., Area della Ricerca di Roma (IT)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37702 (STEV-FBT—87-39) **Reduction of NO in flue gases by adding NH_3.** Andersson, L. (Statens Energiverk, Stockholm (Sweden)). Oct 1987. 18p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752953/JAW.

A theoretical study has been made of the mechanism in order to provide a better understanding of this process for decreasing NO emission from combustion units. A number of programs have been developed for this project, in conjunction with other projects, including: a. Equilibrium program to describe the composition of the flue gas. b. Program for NO reduction by ammonia. c. Data base program to compute thermodynamic and kinetic data from data bases and mechanisms. From simulations of the influence of the conditions on the reduction of NO, a number of conclusions have been made. a. Reduction at optimum temperature is nearly independent of NO concentration. b. Leaner conditions give reduced removal of NO. c. Addition of water to flue gases reduces reduction. Fuels with high content of hydrogen also decrease reduction of NO due to production of water. d. A surplus of ammonia compared to NO improves NO removal for reasonable residence times. e. The residence time is of crucial importance to the reduction. An increased residence time gives marked improval in reduction. f. The temperature is also a critical parameter, with a narrow window centred on 1250 K giving optimum reduction. g. The combination of long residence time and a surplus of ammonia has the potential for nearly complete reduction. Global sensitivity analyses have been done using the 'brute force' method for all reactions. In conclusion, the molecular interpretation of the NO reduction by ammonia gives a consistent picture of the process with the experimental data over different conditions.

37703 (STEV-FBT—88-3) **Emissions from landfill deposition gas plants.** Hoejlund, A. (Statens Energiverk, Stockholm (Sweden); Miljoekorsulterna i Studsvik AB, Nykoeping (Sweden)). Dec 1987. 55p. (In Swedish). (MKS—87-100). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752955/JAW.

Measurements of gas fuels and flue gases from two plants for landfill deposition gases have been performed during September 1987. One of the plants has a gas boiler for hot water production and the measurement has been made at the stack. The second plant is made for drying purposes and the measurements have been performed in the surplus gas flame. The following components have been determined: chlorine,freons, polycyclic aromatic hydrocarbons, mercury, cadmium, lead, zinz, chlorine phenols and benzenes. The contents of pollutants were low when compared with refuse burning.(G.B.).

37704 (STEV-FBT—88-5) **Sulphur capture in a fluidized bed combustor. The effect of temperature.** Lyngfeldt, A. (Statens Energiverk, Stockholm (Sweden); Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Energy Conversion). 1987. 79p. (CTH-IE-A—87-167). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752957/JAW.

The influence of temperature on the reaction of SO/sb2/ with lime is studied. It is found that the SO/sb2/ capture decreases markedly with temperature at temperatures above 860-880 degrees C. When temperature is increased to above 900 degrees C the degree of sulphur absorption decreases momentarily to zero or possibly even below zero. This result suggests that previously captured SO/sb2/ is released at high temperatures. The temperature dependence is also found to remain long after the lime addition was stopped (50 hours) and when the net sulphur absorption is approximately zero. Only one of the theories proposed in the literature on the temperature dependence of fluidized bed sulphur capture can fully explain the observations made in this study. According to this theory CaSO/sb4/ is reduced by CO at reducing conditions and at high temperatures. The continuous limestone addition to a bed initially consisting of silica sand resulted in a substitution of the bed material with CaSO/sb4/ and CaO. The lime accumulated in the bed is still active as a sorbent after a long time, i.e. one or two days, in the bed. (71 references, 39 figures)

37705 (SVF—245) **Emission and reduction of NOsub(x) in premixed natural gas-air flames.** Holmstedt, G. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Jan 1987. 27p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752979/JAW.

The object of this work was to study the suppression of NOsub(x) formation in premixed natural gas-air flames. The control techniques studied were: changes in the geometry (flame holder and length of combustion chamber), load reduction, air preheating, flue gas recirculation and fuel-air ratio. The experiments were performed with a square flame holder and an insulated square combustion chamber at a power of 35-50 kW. The flue gas was externally recirculated and the combustion air was electrically preheated. The emission of NOsub(x), CO, CO/sb2/ and HC was measured using cheminiluminescent (NOsub(x)), infra-red (CO, CO/sb2/, HC) and paramag netic (O/sb2/) analysers. The evaluation of the measurements showed that the emission of NOsub(x), CO and HC could be controlled in a short combustion chamber if flue gas recirculation was combined with preheated air.

37706 **(SVF—247) Evaluation of EMP dilution system for the measurement of emissions into air.** Hellen, G. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Jan 1987. 35p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88753342/JAW.

A sampling system based on the dilution probe technology (EPM, Environment and Process Monitoring, diluted stack sampler) has been studied from a theoretical and field experience point of view. The dilution probe technology may be generically defined as a sampling technique whereby a small continuous sample is filtered and diluted at stack temperature prior to conveyance to a set of analyzers. This is done with an instack venturi, in which preheated instrument air serves the triple function of extracting the sample, diluting it, and conveying it under pressure to the remote analyzers. The dilution probe sampling technology has provided a relatively easily installed, accurate alternative with lower maintenance costs to conventional sampling systems. Variation of the flue-gas pressure and temperature and differences in the reference- and flue-gas -densities will decrease the accuracy of the EPM dilution stack sampler. Laboratory evaluation shows that an increase (decrease) in the absolute flue-gas leads to a similar percentual increase (decrease) in the reading of the analyzer. A change in the flue-gas temperature by 10 degrees centigrade will lead to an analyzer reading error of 1 per cent. The reference-gas commonly being used has a density of 1.25 kg/m/sup3/ norm. The density of the flue-gas is usually 1.5 - 1.35 kg/m/sup3/ norm. Field experiences associated with the use of the EPM diluting stack sampler show no technical problems in applications to ducts with low dust loading (after the precipitator). (authors).

37707 **(SVF—262) Testing of reference gases, SO/sub2/ and NO.** Hellen, G. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). May 1987. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752986/JAW.

Twenty SO/sub2/ and twentyone NO reference gases were collected from seventeen users of calibration standards. These standards contained sulphur dioxide in nitrogen (50-850 ppm) and nitric oxide in nitrogen (30-1000 ppm). The accuracies of the producers' certified concentrations were significantly better for nitric oxide cylinders than for those of sulphur dioxide. For both types of standards 95% of the producers' certified concentrations were accurate to within +- 15%. About 15% of the sulphur dioxide cylinders were accurate to within +- 2%. The corresponding number of nitric oxide cylinders were about 50%. In general the producers' certified concentrations were less accurate than obtained by USA/EPA in 1985/4/, but significantly more accurate than USA/EPA obtained in 1981/3/. No significant differences in accuracies were obtained as a result of assumed long-term instabilities.

37708 **(SVF—268) Fluid dynamic aspects of sorbent injection for SOsub(x) control, a prestudy.** Ljung, L. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Jun 1987. 31p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752988/JAW.

Sulphur can be removed from flue gases through direct in furnace injection of a suitable sorbent. Several conditions must be fulfilled in order to achieve an efficient desulphurization. This prestudy is however only concerned with the fluid dynamics aspects of sorbent injection. For efficient desulphurization it is of course necessary to get a good mixing of the sorbent particles with the flue gas. The hold up time of the particles should be long enough in a suitable temperature interval. For design of the sorbent injection system it is necessary to have a detailed knowledge of flow patterns, flue gas velocities and temperatures in the furnace. An extensive use of measurements and fluid flow modeling is thus required. Discussed in the report are different fluid dynamic aspects that are of importance, e.g. turbulence and particle inertia. In some cases numerical values for different entities with dimension time can be estimated and compared. An implication of that is the importance of using a sorbent with small enough particle size.

37709 **(SVF—274) Optimization of desulphurization by means of injecting limestone into the grate-fired furnace at Kalmar.** Aabom, J. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Aug 1987. 101p. (In Swedish). NTIS (US Sales Only), PC A06. Order Number DE88753346/JAW.

The investigations showed that a considerable reduction of the SO_2-content in the flue gases could be made by a special injection mechanism with injections of finely ground dolomite in the furnace. With a CaS-proportion of 1.67, 65% SO_2 was separated. The coal had a sulphur content of 0.55%. The tested injection-mechanism is especially suitable because of its capacity to separate the isolated particles and maintain this separation during transportation to the furnace. Through this, small-grained material with large specific surface can be exploited very efficiently. The emission of NO/sub x/ was significantly influenced by the dolomite injection. The dust emission was reduced in spite of the increased dust quantity that was fed to the electrostatic dust separators. Ordinary soot blowers kept the surfaces sufficiently clean during the tests. The total cost for equipment, energy and absorbent is about SEK 0.014 kWh with the above stated data for coal. The cost depends very much on the price for dolomite and the coals sulphur-content.

37710 **(SVF—278) Continuous measurements of SO/sb2/, NO, CO/sb2/ and flow velocity.** Nyquist, G.; Radoe, J.; Vesely, V. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); National Swedish Environmental Protection Board, Solna). Sep 1987. 81p. (In Swedish). (SNV—3368). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752989/JAW.

Simultaneous measurements of flow velocity and concentrations of SO/sb2/, NO and CO/sb2/ have been performed in a stack at the heat and power station of Vaesteraas during two firing seasons. The reliability of the measuring system has been tested at continuous drift. Mass flows of sulfur and nitrogen oxides have been calculated. Some results: - The measured values for gas concentrations and flow velocity often varied considerably during the day which depended on variations in the coal consumption. - The number of data that must be collected to calculate a correct mean value depends on the process that is supervised. For the investigated heat and power station, one hour mean values were found to be sufficient. - The 24 hour mean values for the measured parameters of the investigated heat and power station were calculated from one hour mean values. - Before a new measuring system is working well, a lot of improvements have to be done. The results will be further tested by a new measuring program that uses a dilution system instead of an extractive system for the gas preparation. (authors).

37711 **(SVF—280) NOsub(x) measurements at Soedertaelje and Helsingborg. Step 1 Measurement at the Igelsta Plant.** Fransson, K. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Oct 1987. 32p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88753349/JAW.

The measurements of the NOsub(x)-emission after boiler P3 at the Igelsta Plant were carried out during the firing of two coal qualities, one from Poland and the other from England. The nitrogen content of the Polish coal was 1.2 per cent and that of the English coal was unexpectedly low, 1.5 per cent. All measurements have bee carried out close to the maximum effect of the boiler, which is 120 MW. The measurements when firing with the Polish and the English coal, respectively, shows that it has been possible to reduce the NOsub(x)-emission of the air distribution to the boiler with approx 13 per cent and 18 per cent, respectively, counted as NO/sub2/, down to 0.15 g/MJ fuel. The NOsub(x)-reduction was thus moderate despite heavily trimmed burners and with the boiler load constantly kept close to 100 per cent during the respective tests. When judging the results it should, however, be observed that the NOsub(x)-emission was fairly low at a normal adjusted boiler, approx 0.17 and 0.18 g/MJ, respectively, when firing with Polish and English coal, respectively. When the boiler was optimally adjusted and fired with Polish coal the air temperature leading to the wind boxes was decreased with 42 degrees centigrade, whereby an additional marginal reduction of the NOsub(x)-emission of 3 per

cent was received. Tests of short duration show that the NOsub(x)-emission is reduced when firing with O/sub2/-content less than 2.5 per cent in the fluegas. At normal load regulated operations the boiler cannot be fired with such a low excess of air, because of the severe decrease in carbon burnout.

37712 **(TUM-LSM—87/8) Off-gas concentrations in the vicinity of buildings in case of off-gas gas discharge through the roof and walls. Final report.** Jacobs, U.; Pernpeintner, A. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Stroemungsmechanik). 1987. 96p. (In German). Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Stroemungsmechanik.

This is a bibliographic study in which pollutant concentrations on the outer walls of buildings after exhaust discharge through the roof and walls are compared using empirical diffusion models. Pollutant concentrations on the roof and walls depend on the dilution of the off-gas. This means that pollution is low if stacks are at least 2,5 times as high as the building, while furnaces on the outer walls present a pollution problem. Model calculations are carried out to compare both types of pollutant emission.

37713 **(UCID—21355) An environmental analysis of metal particle dispersion from an explosive test at Tonopah Test Range.** Shinn, J.H. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008410/JAW.

The purpose of this report is to estimate the potential environmental effects resulting from a single explosive release of metal aerosols. The source of metal aerosols was a test-unit of an artillery projectile known as the XM785, which was detonated on the ground at Tonopah Test Range, Nevada, on August 6, 1987. The XM785 contained small amounts of beryllium (Be) and depleted uranium (DU) which formed particles in the smoke and stem of the cloud following explosion. The test unit was detonated in the middle of a barren dry lake (playa) known as Antelope Lake. The area surrounding Antelope Lake is sparsely vegetated with the Great-Basin type of shrub-chapparal of sage brush and grass species. The vegetation is lightly grazed by wild horses. Rodents are common and the major predator is the coyote. There are no aquatic biological resources in the area. The test was conducted under carefully controlled and monitored conditions to provide data in preparation for a proposed test series. Of chief environmental concern are the effects of Be and DU as potential agents of toxicity, resulting from exposure to the airborne metal particles or from their deposition. Data concerning the downwind concentration and deposition of Be and DU have been obtained from previous tests of a larger projectile, the XM753. The XM785 contained about one-half the Be and DU found in the XM753. 40 refs., 3 figs., 6 tabs.

37714 **(UCRL—15913) GEOTOX multimedia compartment model: User's guide.** McKone, T.E.; Gratt, L.B.; Lyon, M.J.; Perry, B.W. (Lawrence Livermore National Lab., CA (USA); IWG Corp., San Diego, CA (USA)). May 1987. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008040/JAW.

This report describes how to use the GEOTOX programs. GEOTOX is a set of programs designed to calculate time-varying chemical concentrations in multiple environmental media and to estimate potential human exposures. The report provides a description of the partitioned environment that is modeled by GEOTOX, discusses the theoretical basis for compartment models, and presents the design criteria against which the model is judged. This is followed by a description of what the user must do to run GEOTOX on a particular system. A step-by-step tutorial for running GEOTOX programs is provided. A discussion of the functions of the GEOTOX models is given. Finally, a discussion of model inputs and outputs is provided. 3 refs., 8 figs.

37715 **Introduction of formate and acetate ions into precipitation: Assessment of possible pathways.** Chapman, E.G.; Sklarew, D.S. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US)). pp 219-228 of The chemistry of acid rain: Sources and atmospheric processes. Johnson, R.W.; Gordon, G.E.; Calkins, W.; Elzerman, A.Z. Washington, DC; American Chemical Society (1987). (CONF-8604366—).

From Chemistry of acid rain; New York, NY, USA (13 Apr 1986).

Statistical analysis of data from three sites in the eastern United States suggests that little or no correlation exists between low molecular weight organic and inorganic ion concentrations in precipitation, whereas organic ions such as formate and acetate are highly correlated and are probably introduced into precipitation by the same pathway. Based on agreement between observed and calculated potential clear air concentrations of formic and acetic acids, the most plausible pathway involves the scavenging of gas-phase-produced precursors. Further assessment of atmospheric hydrocarbon reactions is needed to better identify specific mechanisms and precursors in this pathway.

37716 **Accommodation coefficients of ozone and SO_2: Implications on SO_2 oxidation in cloud water.** Tang, I.N.; Lee, J.H. (Environmental Chemistry Div., Brookhaven National Lab., Upton, NY (US)). pp 109-119 of The chemistry of acid rain: Sources and atmospheric processes. Johnson, R.W.; Gordon, G.E.; Calkins, W.; Elzerman, A.Z. Washington, DC; American Chemical Society (1987). (CONF-8604366—).

From Chemistry of acid rain; New York, NY, USA (13 Apr 1986).

Interfacial mass transfer of trace gases into aqueous phase is investigated in a UV absorption-stop flow apparatus. For the first time, the mass accommodation coefficients are determined for O_3 (5.3×10^{-4}) and for SO_2 ($>2 \times 10^{-2}$). The results are incorporated into a simple model considering the coupled interfacial mass transfer and aqueous chemistry in cloud drops. it is shown that dissolution of O_3 into a drop is fast compared with its subsequent oxidation of dissolved SO_2. In addition, the conversion rate of S(IV) to S(VI) in aqueous drops by ozone reactions is not limited by interfacial resistance.

37717 **Field comparison study of polyurethane foam and XAD-2 resin for air sampling of polynuclear aromatic hydrocarbons.** Chuang, J.C.; Hannan, S.W.; Wilson, N.K. (Battelle Columbus Div., Columbus, OH (US)). pp 21-29 of Measurement of toxic and related air pollutants: Proceedings of the 1987 EPA/APCA symposium. Pittsburgh, PA; Air Pollution Control Assoc. (1987). (CONF-8705149—).

From EPA/APCA symposium on measurement of toxic and related air pollutants; Research Triangle Park, NC, USA (3 May 1987).

A study of the sampling efficiency for PAH in vapor using two adsorbents, XAD-2 resin and polyurethane foam (PUF) was performed under summer and winter ambient conditions. Two aspects were investigated: (1) collection efficiency for ambient PAH vapor and (2) retention efficiency for native and perdeuderated PAH spiked onto the adsorbents before sampling. Some spiked PAH which were volatile or reactive were recovered more efficiently with XAD-2 than with PUF. Lower sampling temperature improved the recovery for volatile PAH using PUF, but the recoveries of reactive PAH, such as cyclopenta[c,d]pyrene, were not improved at lower temperature for either adsorbent. An investigation of the stability of PAH collected on quartz fiber prefilters and XAD-2 or PUF backup traps as a function of the storage time was also carried out. Storage at room temperature in the dark for 30 days did not have an adverse effect on the collected ambient PAH or on the spiked perdeuterated PAH with XAD-2 resin. However, a decreasing concentration trend with storage time for naphthalene, anthracene and D_{12}-benzo[a]pyrene collected or spiked on PUF was found. Most of the particle-bound PAH collected on quartz fiber filters were not affected significantly during storage, except that cyclopenta[c,d]pyrene decreased to approximately half the original level after 30 days of storage. Investigation of the degradation product of cyclopenta[c,d]pyrene, pyrene dicarboxylic acid an-

hydride, showed that the levels of this compound collected on filters increased to about 1.5 times the original value after storage for 30 days.

37718 **Supercritical fluid extraction and recovery of PAH from air-borne particulates.** Hawthorne, S.B.; Miller, D.J. (Univ. of North Dakota, Energy Research Center, Campus Box 8213, Grand Forks, ND (US)). pp 63-68 of Measurement of toxic and related air pollutants: Proceedings of the 1987 EPA/APCA symposium. Pittsburgh, PA; Air Pollution Control Assoc. (1987). (CONF-8705149—).

From EPA/APCA symposium on measurement of toxic and related air pollutants; Research Triangle Park, NC, USA (3 May 1987).

Supercritical fluid extraction of PAH from particulates has several potential advantages over traditional methods such as Soxhlet extraction and sonication with liquid solvents. The solvent strengths of supercritical fluids can equal or surpass those of liquids, and can easily be controlled by choice of the supercritical fluids, the extraction pressure, or the addition of solvent modifiers. Many supercritical fluids are gases at room temperature which simplifies analyte concentration steps. The authors developed methodology for the supercritical fluid extraction of PAH from particulate samples that yields good recovery, requires only small (1-50 mg) samples, and is simple and rapid to perform. Supercritical ethane, CO_2, and N_2O (with and without 5% methanol modifier) have been evaluated for their ability to extract PAH from urban dust and fly ash. The most effective supercritical fluid (N_2O with 5% methanol modifier by volume) yielded quantitative recovery of PAH from urban dust (SRM 1649) in as little as 30 minutes. In general, 60 minute extractions of PAH from fly ash with supercritical N_2O5% methanol gave better recoveries than four hours of sonication or eight hours of Soxhlet extraction using either benzene or methylene chloride. A method for the direct coupling of the supercritical fluid extraction step with GCMS and GCFID has also been developed that allows for maximum sensitivity by transferring all of the extracted analytes directly into the gas chromatographic column for cryogenic trapping prior to gas chromatographic analysis. Analysis of PAHs from urban dust (SRM 1649) using coupled supercritical fluid extraction with GCMS gave good agreement with certified values.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 35734, 35874, 35876, 36347, 36597, 36609, 36626, 37625, 37772, 37839, 37975, 38004, 38016, 38139, 38893, 38921, 38922

37719 **(BMU—1987-162) Investigation of the transport of tritium in the environment. Final report.** Koenig, L.A.; Fark, S.; Hempelmann, S.; Langguth, K.G.; Pagliosa, G.; Papadopoulos, D.; Strack, S. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). 1987. 59p. (In German). (KFK—4131). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The surface area exposure through tritium washout by rain or snow can be described with the same model or the same constant $a = 3 \times 10^{-9}$ a mm^{-1} and s^{-1}. This constant can be applied both to single cases and to calculating the long-term mean. A limit is set in so far as the agreement cannot be used for the single washout event, but only for the average of many single events. The time-dependent tritium accumulation by plants is not taken into account by the 'specific activity model', but mean values of air, soil, and plant humidity can be compared.

37720 **(ES/ESH—4/V3) Environmental surveillance of the US Department of Energy Paducah reservation and surrounding environs during 1987.** Rogers, J.G.; Ashburn, D.L.; Aaron, M.R. (ed.). (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Paducah Gaseous Diffusion Plant, KY (USA)). Apr 1988. Contract AC05-84OR21400. 200p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88010748/JAW.

This two-part report reflects the results of a comprehensive, year-round program to monitor the impact of operations at the Paducah Gaseous Diffusion Plant (PGDP) on the area's groundwater and surface waters, soil, air quality, vegetation, and wildlife. In addition, an assessment of the relative effect of PGDP effluents on the resident human population is indicated. Environmental monitoring systems at PGDP include emission monitoring networks for airborne and aqueous discharges, groundwater, solid wastes, and ambient sampling networks for air, surface water, vegetation, food crops, fish, wildlife, soil, surface stream sediments, and radionuclide levels. The results of analyses and investigations are presented in this report and the major findings are summarized.

37721 **(EUR—10947) Environmental radioactivity, Ispra 1985.** Dominici, G. (Commission of the European Communities, Ispra (Italy). European Scientific Data Processing Center). 1987. 43p. (In Italian). Commission of the European Communities, Luxembourgh.

In this report there are briefly described the measurements of environmental radioactivity performed during 1985 by the site survey group of the Radioprotection Division at the Joint Research Centre Ispra Establishment. Data are given on the concentrations of ^{90}Sr, ^{137}Cs, and other radionuclides in precipitation, air, waters, herbage, milk and radioactive effluents. The environmental contamination is mainly world-wide fall-out.

37722 **(PNL—6464) Environmental monitoring at Hanford for 1987.** Jacquish, R.E.; Mitchell, P.J. (eds.). (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 272p. NTIS, PC A12/MF A01;1; GPO Dep. Order Number DE88011766/JAW.

Envoronmental monitoring activities performed on the Hanford Site for 1987 are discussed in this report. Samples of environmental media were collected to determine radionuclide and chemical concentrations at locations in the geographical area. Results are discussed in detail in subsequent sections of this report. Surveillance of radioactivity in the Hanford vicinity during 1987 indicated concentrations well below applicable DOE and US Environmental Protection Agency (EPA) standards. Radioactive materials released from Hanford operations were generally indistinguishable above background in the offsite environment. Continued influence from the 1986 reactor accident at the Chernobyl Nuclear Power Station in the USSR was not apparent this year. Chemical concentrations in air were below applicable standards established by the EPA and the State of Washington. Chemicals detected in the ground water beneath the Site can be attributed to both Site operations and natural background levels. Several chemicals regulated by the EPA and the State of Washington exceeded EPA drinking water standards (DWS). 106 refs., 71 figs., 110 tabs.

37723 **(SAND—88-0697) 1987 environmental monitoring report: Sandia National Laboratories, Albuquerque, New Mexico.** Millard, G.; Pei, P.; Felicetti, S.; Gray, C.; Thompson, D.; Phelan, J. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 4p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88010368/JAW.

Sandia National Laboratories Albuquerque (SNLA) is located south of Albuquerque on Kirtland Air Force Base. Because radionuclides are potentially released in small quantities from its research activities, SNLA has a continuing environmental monitoring program which analyzes for cesium-137, tritium, uranium, alpha emitters, and beta emitters in water, soil, air, and vegetation. Measured radiation levels in public areas were consistent with local background in 1987. A total of 7.7 curies of argon-41 were released as a result of SNLA operations in 1987. The Albuquerque population received an estimated 0.058 person-rem from airborne radioactive releases, whereas it received greater than 44,100 person-rem from naturally occurring radionuclides. A nonradioactive effluent monitoring program has been started at SNLA which includes groundwater, stormwater, and sewage monitoring. Results indicate that groundwater quality conformed the USEPA drinking water standards. Preliminary testing of stormwater showed that no pollutants were above minimum detectable levels. A program to investi-

gate potential remedial action sites has been started. 36 refs., 9 figs., 111 tabs.

37724 **(SAND—88-8206) 1987 environmental monitoring report, Sandia National Laboratories, Livermore, California.** Devlin, T.K. (Sandia National Labs., Livermore, CA (USA)). Apr 1988. Contract AC04-76DR00789. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011284/JAW.

Sandia National Labortories conduct various research activities related to Department of Energy interests which have the potential for release of hazardous materials or radionuclides to the environment. A strict environmental control program places maximum emphasis on limiting releases. The environmental monitoring program conducted by Lawrence Livermore National Laboratory and augmented by Sandia is designed to measure the performance of the environmental controls. The program includes analysis of air, water, soil, vegetation, sewer effluent, ground water, and foodstuffs for various toxic, hazardous, or radioactive materials. Based on these studies, the releases of materials of concern at Sandia during 1987 were well below applicable Department of Energy standards. 8 refs., 3 figs., 12 tabs.

5004 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 38922

37725 **Truncation effects on estimated parameters of tracer distributions sampled on finite domains.** Holland, J.Z. (Department of Meteorology, University of Maryland, College Park, Maryland). *Journal of Applied Meteorology;* 27: No. 3, 280-294(Mar 1988).

Methods are presented and demonstrated for compensating for the apparent effects of truncation of the sampled crosswind distribution of a tracer, at either or both boundaries of a surface sampling grid downwind from the point of release. Errors and corrections on estimates of the apparent vertical mixing depth, h, the location of the centroid of the crosswind distribution, y-bar, and the crosswind dispersion parameter, σ/sub y/, are those which would apply to a truncated Gaussian distribution having the observed moments (zeroth, first and second). For truncation on only one side of the tracer cloud, a linear relationship between certain measurable quantities based on moments of partial distributions is used to derive the parameters of a best-fit truncated Gaussian distribution by linear regression. The methods are illustrated by an example from the Cross Appalachian Tracer Experiment and by a Gaussian simulation.

37726 **Aqueous-phase reactions in clouds.** Schwartz, S.E. (Environmental Chemistry Div., Brookhaven National Lab., Upton, NY (US)). pp 93-108 of The chemistry of acid rain: Sources and atmospheric processes. Johnson, R.W.; Gordon, G.E.; Calkins, W.; Elzerman, A.Z. Washington, DC; American Chemical Society (1987). (CONF-8604366—).

From Chemistry of acid rain; New York, NY, USA (13 Apr 1986).

Reaction of dissolved gases in clouds occurs by the sequence gas-phase diffusion, interfacial mass transport, and concurrent aqueous-phase diffusion and reaction. Information required for evaluation of rates of such reactions includes fundamental data such as equilibrium constants, gas solubilities, kinetic rate laws, including dependence on pH and catalysts or inhibitors, diffusion coefficients, and mass-accommodation coefficients, and situational data such as pH and concentrations of reagents and other species influencing reaction rates, liquid-water content, drop size distribution, insolation, temperature, etc. Rate evaluations indicate that aqueous-phase oxidation of S(IV) by H_2O_2 and O_3 can be important for representative conditions. No important aqueous-phase reactions of nitrogen species have been identified. Examination of microscale mass-transport rates indicates that mass transport only rarely limits the rate of in-cloud reaction for representative conditions. Field measurements and studies of reaction kinetics in authentic precipitation samples are consistent with rate evaluations.

37727 **Chemical instrumentation of atmospheric wet deposition processes.** Tanner, R.L. (Environmental Chemistry Div., Dept. of Applied Science, Brookhaven National Lab., Upton, NY (US)). pp 289-303 of The chemistry of acid rain: Sources and atmospheric processes. Johnson, R.W.; Gordon, G.E.; Calkins, W.; Elzerman, A.Z. Washington, DC; American Chemical Society (1987). (CONF-8604366—).

From Chemistry of acid rain; New York, NY, USA (13 Apr 1986).

Field studies of wet deposition processes require the differentiation and determination of many reactive species at trace levels in clear-air gaseous and aerosol phases and in air containing clouds and precipitation. These studies have placed extremely rigorous requirements on existing analytical techniques and, in several instances, required development of new approaches to sampling and determination of critical species. Measurement techniques for nitrogen oxides and oxyacids, SO_2 and aerosol sulfate species, oxidant species including hydrogen peroxide and PAN, and various organic species in the gas, aerosol and, where appropriate, aqueous phases from airborne platforms are reviewed. Emphasis is on recent developments in real-time and short-term integrated measurements which permit the differentiation of below-cloud, within-cloud (interstitial), and aqueous phase species concentrations of oxidants, and of sulfuric and nitric acids and their precursors. Recent developments in measurement techniques for nitrogen oxides and gaseous H_2O_2 applicable to airborne sampling are highlighted.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 36227, 37842

37728 **(DOE/ID/12082—87) 1987 environmental monitoring program report for the Idaho National Laboratory site.** Chew, E.W.; Mitchell, R.G. (USDOE Idaho Operations Office, Idaho Falls. Radiological and Environmental Sciences Lab.). May 1988. Contract AS07-80ID12082. 69p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010304/JAW.

The results of the various monitoring programs for 1987 indicate that radioactivity from the Idaho National (INEL) Site operations could not, with the exception of Sb-125 in air, be distinguished from worldwide fallout and natural radioactivity in the region surrounding the Site. Although some radioactive materials were discharged during Site operations, concentrations and doses to the surrounding population were of no health consequence and were far less than State of Idaho and Federal health protection guidelines. This report describes the monitoring program, the collection of foodstuffs at the INEL boundary and distant offsite locations, and the collection of air and water samples at onsite and offsite boundary and distant locations. The report also compares and evaluates the sample results, discussing implications, if any. Significant environmental activities at the INEL Site during 1987, nonradioactive and radioactive effluent monitoring at the Site, and the US Geological Survey (USGS) ground-water monitoring program are also summarized. 33 refs., 13 figs., 13 tabs.

37729 **(SAND—88-0698) 1987 Environmental monitoring report: Tonopah Test Range, Tonopah, Nevada.** Millard, G.C.; West, G.L. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010106/JAW.

The Tonopah Test Range is located about 140 air miles northwest of Las Vegas, Nevada, and covers 624 square miles within the Nellis Air Force Base Bombing and Gunnery Range. The range is used for various US DOE and US DOD program tests that are critical to national defense. Activities that affect the environment are mainly road construction, preparation of instrumentation sites, and disturbance of the terrain from weapons testing. Monitoring of the test range is done routinely by the US Environmental Protection Agency (EPA) to supplement Sandia's monitoring effort associated with Sandia test activities. EPA monitoring results for 1987 indicate that test range operations do not adversely affect the off-site environment or the public. 14 refs., 2 figs., 9 tabs.

5006 Regulations

REFER ALSO TO CITATION(S) 36486, 36487, 36489

37730 **(SNV—3090) International evaluation of the environmental monitoring program, PMK.** (National Swedish Environmental Protection Board, Solna). Dec 1985. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752946/JAW.

In 1978, the National Environmental Protection Board (SNV) in Sweden was commissioned by the Government to initiate the construction of a National Environmental Monitoring Programme, known as PMK. The following three major aims were set up for PMK through a decision process in Parliament and the Swedish Government. The overall programme design is based on them: - to monitor long-term and large-scale changes in the environment and in that way identify problems; - to collect data about environmental conditions in relatively unaffected tracts to permit well-founded assessments of the situation in more heavily impacted areas; - to illuminate how pollutants are transported. The evaluation of PMK made by an international Panel of experts has clearly shown this Programme generally to be of high quality and well under way to become ideally adapted to its aims. It is also our impression that PMK even in its present form yields very high value for the relatively small amounts of money it spends. We think PMK should be regarded as an asset both nationally and in an international perspective. The Panel concentrated most of its plenary discussions on PMK as a whole; several matters raised in connection with a special project or subprogramme were also found to be of a more general nature. Special attention is given in the report to conditions considered by us to be either excellent or less satisfactory, whereas conditions merely regarded as satisfactory are mentioned only briefly or not at all.

37731 **(SNV—3122) PMK - from the users point of view.** Engberg, H.; Swaren, U. (National Swedish Environmental Protection Board, Solna). 23 Apr 1986. 62p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752942/JAW.

This report gives an evaluation of the Environmental Monitoring program, PMK, from the users point of view. Several suggestions are given for measures that might increase the possibilities to use PMK data in routine environmental protection work. The report may also serve as an introduction to the activities present in the PMK project.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 38143

5101 Basic Studies

REFER ALSO TO CITATION(S) 37789

37732 **(AAEC/E—651) Neutron moisture probes : the minimum error attainable.** Wilson, D.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702834/JAW.

The effect of the soil parameters dry density, mass absorption and mass scattering coefficients on the neutron flux at the detector of a neutron moisture probe has been described previously by a set of polynomial equations. The partial derivatives of these equations have been used to determine the deviation introduced into water density calculation by a one per cent inaccuracy in each of the parameters. Accuracy of measurement of the soil parameters is discussed and applied to a typical soil at various water densities. The accuracy to which soil parameters can be measured is examined and found to be approximately +- 2% for the dry soil density, +- 1% for the mass absorption coefficient and +- 2% for the mass scattering coefficient. Using these data, together with a statistical accuracy of +- 1% in the probe count rate, the minimum error achievable for the water density varies between +- 3.5% at a water density of 0.06 g cm^{-3} and +- 1.55% at a water density of 0.41 g cm^{-3}.

37733 **(CONF-8804148—1) Error propagation and uncertainty in process modeling.** Gardner, R.H.; Dale, V.H.; O'Neill, R.V. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011836/JAW.

From Conference on forest growth: process modeling of response to environmental stress; Gulf Shores, AL, USA (19 Apr 1988).

The principles and procedures for estimating uncertainties associated with model predictions have been extensively studied and applied to a broad spectrum of models. These studies have quantified relationships between data input, parameter estimation, and model results. Uncertainty analyses have also determined how additional data can improve the precision and reliability of predictions. The current challenge in applying error propagation techniques to forest process models lies with the development of a conceptual framework that can distinguish between: (1) effects due to stochastic variables such as weather; (2) the uncertainties associated with the measurement of detailed physiological processes; and (3) the variability in results caused by local stand-level phenomena.

37734 (INIS-BR—1018, pp 15) **Studies of the quantity variation of carbon-14 labelled pesticides in samples of soil from Northeastern, Brazil.** Farias, V.S.O.; Queiroz, F.G. de; Precker, J.W. (Paraiba Univ., Campina Grande (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

37735 (INIS-BR—1018, pp 16) **Study of the motion of carbon-14 labelled pesticides in samples of soil from Northeastern Brazil.** Queiroz, F.G. de; Farias, V.S.O.; Precker, J.W. (Paraiba Univ., Campina Grande (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

37736 **(ORNL/CDIAC—24-Vol.1) Bibliography on tropical rain forests and the global carbon cycle: Volume 1, An introduction to the literature.** Hall, C.A.S.; Brown, S.; O'Hara, F.M. Jr.; Bogdonoff, P.B.; Barshaw, D.; Kaufman, E.; Underhill, S. (Oak Ridge National Lab., TN (USA). Carbon Dioxide Information Analysis Center). May 1988. Contract AC05-84OR21400. 169p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88010761/JAW.

This bibliography covers the world literature on tropical rain forests, tropical deforestation, land-use change in the tropics, tropical forest conversion, and swidden agriculture as related to the global carbon cycle. Historic papers and books are included, but comprehensive coverage was only sought for 1980 through 1987. This compendium of nearly 2000 entries forms the point of departure for a series of bibliographies on this topic. Other works in this series will be on the global carbon cycle and rain forests in specific geographic areas, whereas this volume includes references to literature about the global carbon cycle and rain forests anywhere in the world. The bibliography is ordered alphabetically by author and is indexed by subject and author.

37737 **Neutronic properties of Mesaverde Sands: Pt. 1. Calibration of the Advanced Reactivity Measurement Facility.** Lysne, P. (Sandia National Labs., Albuquerque, NM (USA)). *Nuclear Geophysics;* 2: No. 2, 105-112(1988).

The Advanced Reactivity Measurement Facility (ARMF) at the Idaho National Engineering Laboratory is a small, light water moderated reactor. Access to this reactor is made through six experimental holes which possess neutron fluxes with different energy characteristics. When specimens are placed in these holes, thermal and higher energy absorption and scattering produce a linear per-

turbation to the reactor which is measured by movement of the regulating rod. Calibration was accomplished by placing eleven standard specimens in each of the six holes and solving for the appropriate calibration numbers in a least-squares sense. In the course of this calibration, it was found that two of the holes are redundant in that their fluxes are not significantly different from fluxes in the remaining holes. The resulting four-hole calibration yields cross section values with uncertainties of +- 0.2 CU(gmcm^3) for cross sections less than 9 CU(gmcm^3).

37738 **Ecological comparison of sympatric populations of sand lizards (Cophosaurus texanus and Callisaurus draconoides).** Smith, D.D.; Medica, P.A.; Sanborn, S.R. (Univ. of California, Los Angeles (USA)). *Great Basin Naturalist;* **47**: No. 2, 175-185(30 Apr 1987). Contract AC03-76SF00012.

Sympatric populations of Cophosaurus texanus and Callisaurus draconoides were periodically sampled from March 1973 through April 1974 at Burro Creek, Mohave County, Arizona. Callisaurus were also sampled at Rock Valley, Nye County, Nevada. Sex ratios were skewed in favor of males in the adult Cophosaurus but were equal in both adult populations of Callisaurus. Both species became sexually mature as yearlings. Mean clutch sizes were 3.55 (+/- 0.83) for Cophosaurus, and 4.25 (+/- 1.08) and 5.07 (+/- 1.33) for Callisaurus at Burro Creek and Rock Valley respectively. Evidence of multiple clutches was exhibited by both species. Egg weight/body weight ratios for both species and clutch weight/body weight ratios for Cophosaurus were notably smaller than previously reported. At Burro Creek both species were highly insectivorus, with orthopterans comprising the largest food group of each. Niche overlap for food was high at the ordinal level, but at the familial level it is apparent that Callisaurus probably fed in the more xeric areas of the riparian habitat. No differences were found in the temperature responses of these two lizards. However, minor temporal separations and substantial spatial partitioning were observed. Callisaurus preferred sandy open areas, while Cophosaurus preferred the presence of some rocks and boulders. 31 references, 2 figures, 8 tables.

37739 **Burrows of the sagebrush vole (Lemmiscus curtatus) in southeastern Idaho.** Mullican, T.R.; Keller, B.L. (Idaho State Univ., Pocatello (USA)). *Great Basin Naturalist;* **47**: No. 2, 276-282(30 Apr 1987).

Burrows of the sagebrush vole (Lemmiscus curtatus) were analyzed by injecting them with expanding polyurethane foam. Average mean depth +/- 1 SE of four burrows was 12.5 +/- 2.6 cm. Tunnels were wider than high and flat on the bottom. Three of four burrows were nearly linear, with an average of five entrances. Burrows usually contained one nest made of Artemisia tridentat bark. No middens or communal nests were found. The burrow structure in sagebrush habitat suggests that sagebrush voles occur singly or in pairs rather than in colonies.

37740 **Observations of captive Rocky Mountain mule deer behavior.** Halford, D.K.; Arthur, W.J. III; Alldredge, A.W. (Colorado State Univ., Fort Collins (USA)). *Great Basin Naturalist;* **47**: No. 1, 105-109(31 Jan 1987). Contract AS02-76EV01156.

Observations were made near Fort Collins, Colorado on the behavior of a captive herd of Rocky Mountain mule deer (Odocoileus hemionus hemionus). Comparisons in general behavior patterns were made between captive and wild deer. Similar behavior was exhibited by captive and wild deer. Captive deer (as well as other species) may be useful for study of certain behavioral aspects of their wild counterparts.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 36649, 36651, 36922, 36997, 37652, 37653, 37657, 37676, 37677, 37685, 37714, 37722, 37768, 37772, 37781, 37785, 37820, 38026, 38028, 38032, 38042, 38043, 38055, 38056, 38057, 38058, 38059, 38060, 38061, 38062, 38068, 38071, 38088, 38089, 38090, 38091, 38092, 38093, 38094, 38095, 38096, 38097, 38098, 38099, 38101, 38102, 38103, 38104, 38114, 38115

37741 **(AD-A—190447/3/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 4, Fort Worth, Texas. Volume 7. Appendices A-3 and A-4. Final report, September 1985-September 1986.** (Radian Corp., Austin, TX (USA)). Dec 1987. 396p. NTIS, PC A17/MF A01.

See also Volume 8, AD-A190 448.

Soil samples for chemical analysis were submitted to Radian Analytical Services (RAS) Laboratory. The samples were logged in, and the data reported in batches . Each batch submitted was assigned an RAS work order number. Table A.3-1 is a sequential listing of all analytical reports associated with AF Plant 4 Phase II, Stage 1 soil analyses by work order number. Table A.3-2 cross-references soil borings or well numbers, OEHL numbers, and the RAS work order numbers under which the results are located. Methyl ethyl ketone analyses were performed by the Radian chromatography laboratory. The results of these analyses are provided in a memo included in this volume. The RAS reports in the volume are arranged consecutively by RAS work order number. Pages in Appendix A are numbered by the volume number followed by the page number of the that volume. For example, Page 7 001 is Page 1 of Volume 7.

37742 **(AD-A—190448/1/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 4, Fort Worth, Texas. Volume 8. Appendices B-E. Final report, September 1985-September 1986.** (Radian Corp., Austin, TX (USA)). Dec 1987. 162p. NTIS, PC A08/MF A01.

See also Volume 9, AD-A190 449.

The overall objective of the Phase II investigation is to define the magnitude, extent, direction and rate of movement of identified contaminants. A series of staged field investigations may be required to meet this objective. The contractor shall determine any additional investigations required beyond this stage, including an estimate of costs, for possible performance under a separate contractual action. The purpose of this task is to conduct a contaminant source investigation at Air Force Plant 4 to determine: (1) the presence or absence of contamination within the specified areas of the field survey; (2) if contamination exists, the potential for migration in the various environmental media; (3) the extent/magnitude of contamination on the Air Force Plant 4 property; and (4) potential environmental consequences and health risks of migrating contaminants based on state or federal standards for these contaminants.

37743 **(CONF-8804133—1) The potential of trees to record aluminum mobilization and changes in alkaline earth availability.** Bondietti, E.A.; Baes, C.F. III; McLaughlin, S.B. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010437/JAW.

From Workshop on markers of air pollution effects in forests; Asheville, NC, USA (25 Apr 1988).

The mobilization of exchangeable soil cations by atmospheric depositions of mineral acid anions and the distribution of polyvalent cations in the xylem are described to provide the basis for interpreting both radial concentration and concentration ratio patterns of polyvalent cations in annual growth rings of trees. There is strong circumstantial evidence that increases in Al:Ca ratios in annual rings are related to aluminum mobilization, and that changes in the availability of alkaline earth elements and radial growth rated may also be related to cation mobilization. Suggestions for further research are presented.

37744 **(CONF-8804133—2) Markers of air pollution in forests: Nutrient cycling.** Johnson, D.W.; Van Miegroet, H.; Swank, W.T. (Oak Ridge National Lab., TN (USA); Coweeta Hydrologic Lab., Otto, NC (USA)). 1988. Contract AC05-84OR21400. 12p. (CONF-8804133—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011011/JAW.

From Workshop on markers of air pollution effects in forests; Asheville, NC, USA (25 Apr 1988).

Air pollution may alter either the nutrient content or the flux rates in forest ecosystems, but, with a few exceptions (e.g., SO_4/sup 2{minus/} in foliage, Al/sup 3{plus/} or Pb in tree rings), flux measurements provide more sensitive measures of air pollution effects. However, nutrient pools may be significantly affected by air pollution over long periods of time, and the importance of sample archiving as a means of detecting these long-term changes in nutrient pools (e.g., soils) cannot be overemphasized. Acid deposition andor foliar damage by ozone may cause increased foliar leaching, but the degree to which air pollution affects foliar leaching is very difficult to assess in the absence of control sites for comparison. Decomposition may also be altered by increased acid input, trace metal deposition, or gaseous pollution; but, once again, many of these potential changes are very difficult to evaluate for lack of control sites. Acid deposition nearly always influences soil leaching rates to some degree. In the case of SO_4/sup 2{minus/}, reasonable assumptions about background concentrations often allow an approximate estimate of the degree to which leaching is affected by sulfate deposition. For NO_3/sup {minus/}, there is considerably less certainty about exactly what background levels should be. It is therefore more difficult to evaluate the degree to which current NO_3/sup {minus/} leaching rates are affected by atmospheric N deposition without a full analysis of the N cycle of the ecosystem in question.

37745 **(CONF-8805103—1) Developing a hazardous materials evacuation plan.** Newsom, D.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009966/JAW.

From Hazardous material spills conference; Chicago, IL, USA (16 May 1988).

Effective response to hazardous material spills can be aided by development of an evacuation plan, as part of, or as an adjunct to, other emergency response plans. Valuable standards for the development of such plans can be gleaned from corresponding standards published for radiological emergency response plans. Computer aids presently available have some limitations, but can be of significant help in evacuation planning. 5 refs.

37746 **(EPRI-EA—5715) Seminar on remote sensing of forest decline attributed to air pollution: Proceedings.** Nilsson, S.; Duinker, P.N. (Electric Power Research Inst., Palo Alto, CA (USA)). Apr 1988. 252p. (CONF-8703261—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88009901/JAW.

From Seminar on remote sensing and forest decline attributed to air pollutants; Laxenburg, Austria (11 Mar 1987).

The purpose of the seminar was to bring together experts from Europe and North America to review the state of the art in remote sensing of forest decline, and to review a proposal from Sweden for a Europe-wide survey of forest decline using satellite imagery. In addition to presentations on the Swedish proposal, the Seminar included sessions on monitoring of forest resources, and past and current applications of remote sensing to assess forest decline in Europe and North America. The method presented in the proposal by Satimage Corporation of Sweden seems to be efficient in identifying severe damage to forests, but there are problems in identifying light damage. The method has not been evaluated yet for hardwoods. There are great difficulties today in generating a sound picture of the extent of forest decline in Europe and North America. This is a result of the fact that data about forest damage are collected in different ways from country to country. There is a need to develop and employ a standardized monitoring method, and the method presented at the Seminar can play a role in this process. These Proceedings contain papers submitted by authors of 18 of the 21 presentations made at the seminar, plus a summary of the Seminar prepared by the organizers.

37747 **(EPRI-EA—5741) Chromium reactions in geologic materials: Interim report.** Rai, D.; Zachara, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. 263p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88007528/JAW.

This report contains new laboratory data and equilibrium constants for key reactions needed to predict the geochemical behavior of Cr in soils and groudwater. These new data include 1) the solubility of $BaCrO_4$(c) and Ba(S,Cr)O_4(c) solid solutions, 2) the Fe(II)-mediated reduction of Cr(VI) to Cr(III), and 3) Cr(VI) adsorption by kaolinite and Al-substituted goethite. The new mechanistic data along with the previously developed data have improved the understanding of reactions that limit Cr(III) and Cr(VI) mobility in soils and groundwater. Experiments show that both $BaCrO_4$(c) and Ba(S,Cr)O_4(c) solid solution form rapidly under the geochemical conditions expected in the environment. Solubility products were experimentally determined for $BaCrO_4$(c) and for Ba(S,Cr)O_4(c) at several mole fractions of Cr(VI). The Ba(S,Cr)O_4(c) solid solution is of special importance because it maintains lower aqueous Cr(VI) concentrations than $BaCrO_4$(c) and is likely to form and control Cr(VI) mobility in the utility environment, where Ba/sup 2{plus/} levels are controlled by $BaSO_4$(c). The ferrous ion [Fe(II)] was found to be a rapid and effective reductant for Cr(VI) to Cr(III). This redox transformation is important in predicting migration of chromium species because the resulting Cr(III) concentrations in groundwater are kept low by the solubility of $(Cr,Fe)(OH)_3$. Chromium(VI) adsorption was measured on kaolinite and Al-substituted goethite. Both solids adsorb Cr(VI) only under acidic and near-neutral conditions. The observed Cr(VI) adsorption by both solids was described with a multiple-site surface complexation model and binding constants for single-phase oxides. 132 refs., 68 figs., 27 tabs.

37748 (Juel-Spez—413, pp 46-48) **Investigation of the distribution of airborne pollutants and their deposition in forests of the Black Forest and Schoenbuch mountains.** Baumbach, G. (Stuttgart Univ. (Germany, F.R.). Abt. Reinhaltung der Luft). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

37749 (Juel-Spez—413, pp 49-51) **Investigations of wet and dry pollutant deposition in forests of the Black Forest and Schoenbuch mountains.** Baumbach, G. (Stuttgart Univ. (Germany, F.R.). Abt. Reinhaltung der Luft). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

37750 (Juel-Spez—413, pp 52-53) **Gaseous deposition of SO_2, NO/sub x/, and O_3 in a spruce forest and weather-dependent parametrisation of the deposition rates.** Mayer, H.; Enders, G. (Muenchen Univ. (Germany, F.R.). Lehrstuhl fuer Bioklimatologie und Angewandte Meteorologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

37751 (Juel-Spez—413, pp 54-56) **Qualitative and quantitative analysis of potential organic pollutants in the air and on the leaves/needles of forest trees in different sites.** Figge, K. (Natec-Gesellschaft fuer Naturwissenschaftlich-Technische Dienste m.b.H., Hamburg (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

37752 (Juel-Spez—413, pp 60-62) **Investigation of pollution effects in the Frankfurt city forest, with particular regard to car engine emissions. Immission loads of a forest ecosystem in an urban region.** Jaeschke, W.; Maraun, W.; Sattler, T. (Frankfurt Univ. (Germany, F.R.). Zentrum fuer Umweltforschung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

37753 (Juel-Spez—413, pp 63-65) **Investigation of pollution effects in the Frankfurt city forest, with particular regard to car engine emissions. Determination of pollutant deposition in tree crowns using measured data and a numerical model.** Herbert, F.; Jaeschke, W.; Ernst, H.G.; Herrmann, U.; Thomas, J. (Frankfurt Univ. (Germany, F.R.). Zentrum fuer Umweltforschung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

37754 (Juel-Spez—413, pp 66-67) **Dry and wet deposition of heavy metals and noxious gas concentration in a damaged forest ('Postturm' site, Farchau/Ratzeburg forest).** Michaelis, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

37755 (Juel-Spez—413, pp 68-69) **Measurements of chlorinated hydrocarbons in the atmosphere, in hydro meteors, and in soil samples.** Baechmann, K. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich 8 - Anorganische Chemie und Kernchemie im Edward-Zintl-Institut). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

37756 (Juel-Spez—413, pp 70-71) **Volatile halogenated hydrocarbons in the environment.** Frank, H. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Toxikologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

37757 (KTM/E-D—137) **Effects of acid deposition on the catchment area of lake Marsjoen - basic study.** Uotila, I. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Aug 1987. 107p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752825/JAW.

Evidence of the acidification of soil and watercourses observed in Europe and North America has been found in Finland in recent years, too. A study into acidification, financed by Imatran Voima Oy (IVO) and the Ministry of Trade and Industry, has been carried out in Inkoo, in the little Marsjoen lake and its catchment area. The area is situated in the neighbourhood of the coal-fired power plant of Inkoo. The study was begun in 1983 and the present final research report compiles the results from the period 1 July 1983 to 30 June 1986. The objective of the study was to establish the quality of the air-transported compounds and their effects on the ecosystem. During the research period, pH of the rain water in open areas was 4.0-5.0 and under the canopy 3.0-4.5. The annual sulphu deposition was some 1.0 g/m"2, but including the canopy throughfall, the average deposition in the area totalled some 1.7 gS/m"2 annually. Total nitrogen deposition averaged 0.9 g N/m"2 annually. Some 75% of the strong acid in precipitation is caused by sulphuric acid and 25% by nitric acid. The alcalinity values of the lake were relatively high and its buffer capacity has been sufficient to neutralize the acid deposition so far. No signs of acidification in water plants and fishes were observed. The groundwater studies, however, evidenced a decrease in the alcalinity level. The state of forests and forest lands was found normal. An ion budget representing the acidification development in the catchment area was worked out. This budget indicates that the buffer capacity of the soil has been sufficient to neutralize the acid load so far. Acidification of the catchment area thus does not seem to be a concern of the near future.

37758 (LBL—25217) **Transport of a conservative solute through a shallow pond bottom.** Long, R.H.; Benson, S.; Alavi, M.; Narasimhan, T.N. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 20p. (CONF-8804135—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010883/JAW.

From 8. annual AGU front range branch hydrology days; Fort Collins, CO, USA (19 Apr 1988).

A field experiment has been performed in an evaporation pond at Kesterson Reservoir, Merced County, California, aimed at determining average solute fluxes through pond sediments and at estimating the magnitude and degree of spatial variability of water and solute transport properties. Kesterson Reservoir, a series of shallow ponds located at the terminus of the San Luis Drain, became the object of intense public interest and scientific investigation after it was discovered in 1983 that the disposal of irrigation drain waters bearing hazardous levels of a naturally occurring element, selenium, was having serious environmental effects on plant and animal life. The primary focus of the experiment was to gain insight into the mechanism of selenium migration and immobilization. As a first step in analyzing the selenium migration data, permeability and apparent dispersion coefficient values were obtained through the history-matching of breakthrough curves of a conservative solute, chloride, at 40 sampling locations within 5 sites throughout a 40-ha (100-acre) cell following pond-flooding. Chloride occurring naturally throughout the soil profile was utilized in a modeling effort as a conservative tracer under conditions of transient flow, and a deterministic one-dimensional fluid flow and transport mathematical model employing the integrated finite difference method (IFDM) was employed in the effort. 29 refs., 9 figs., 1 tab.

37759 (LUNBDS-NBNB—1013-1-86-1986) **Soil microbial effects of smelter induced heavy metal contamination.** Nordgren, A. (Lund Univ. (Sweden). Dept. of Technical Microbiology). 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753328/JAW.

The soil concentrations of Cu and Zn at the secondary smelter were 20 00 mu g/g dry soil. Close to the primary smelter the soil was contaminated with more than ten elements including Pb, Zn, Cu and As at levels ranging between 6000 and 1000 mu g/g dry soil. The correlations between the concentrations of the metals were high at both smelters. Soil respiration rate decreased by about 75% close to both smelters. Total and fluorescein diacetate stained mycelial lengths decrease with increasing heavy metal pollution at the secondary but not at the primary smelter. The fungal community structure was strongly affected by the contamination. General common in coniferous forest soils such as Penicillium and Oidiodendron virtually vanished, while less frequent species like Paecilomyces farinosus and Geomyces pannorum dominated the site close to the smelter. Colony forming units of a number of functional groups of bacteria were found to be very sensitive to metal contamination. The urease activity of the soil was inhibited. Multivariate statistical analyses showed that the metal contamination was the major environmental influence on the microbiotain the soils studied. A study of about 200 decomposition curves resulting from glutamic acid additions to the different soils produced four

microbially related parameters: basal respiration rate, initial respiration rate after the addition of the glutamic acid, specific respiration rate during the exponential increase of the respiration rate and the lag time before the exponential phase. With 53 refs.

37760 (PB—88-182076/XAB) Accidentally spilled gas-oil in a shoreline sediment on Spitsbergen: natural fate and enhancement of biodegradation. Sveum, P. (SINTEF, Trondheim (Norway)). 29 Dec 1987. 21p. (STF—21-A87111). NTIS, PC E03/MF E03.

The oil-soluble fertilizer Inipol EAP22 has been used on shore as a treatment agent after an accidental marine gas-oil contamination on Spitsbergen. A 60% increase in the biodegradation of the aliphatic fraction was obtained as a maximum. Due to the high rate of physical self-cleaning (about 90%), the importance of the biodegradation for the total self-cleaning was limited.

37761 Terrestrial ecosystems: Wet deposition. Shriner, D.S. (Environmental Sciences Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 365-388 of Air pollutants and their effects on the terrestrial ecosystem. Legge, A.H.; Krupa, S.V. New York, NY; John Wiley and Sons Inc. (1986).

One of the most rapidly growing areas of research into the effects of air pollutants on terrestrial ecosystems during the past decade has been wet deposition of pollutants and the subsequent effects of those precipitation-deposited pollutants on vegetation and soils. The objectives of this paper are to review the state of their collective knowledge on the effects of wet deposition of pollutants, to identify where research to date has left gaps, and to present their views on the future research needs in this area. After a decade of rather intensive research into the effects of wet deposition of pollutants on vegetation, a number of conclusions can be drawn about the way in which wet deposition affects vegetation. This review does not present an account of all of the individual research efforts which comprise their corporate knowledge; instead, it concentrates on those common conclusions they may draw as well as on those inconsistencies which have appeared thus far. On the basis of those commonalities and inconsistencies, perhaps a clearer picture of research needs will emerge.

37762 Effects of gaseous air pollutants on terrestrial vegetation. Heck, W.W.; McLaughlin, S.B. (US Dept. of Agriculture, North Carolina State Univ., Raleigh, NC (US)). pp 325-336 of Air pollutants and their effects on the terrestrial ecosystem. Legge, A.H.; Krupa, S.V. New York, NY; John Wiley and Sons Inc. (1986).

On a global scale, terrestrial vegetation is exposed intermittently to gaseous air pollutants. Under some conditions the exposure may be continuous, but generally the exposure concentrations are variable. Similarly, the response of vegetation is variable depending upon factors both external and internal to the plant. Under some conditions, the effects may be beneficial or benign; under others, the effects may be harmful or disastrous. The effects may be acute or chronic, reversible or irreversible, direct (via foliar absorption) or indirect (via deposition on the soil and uptake by roots). The effects may be a direct result of a specific chemical species or of various combinations of chemical species (e.g., $SO_2 + O_3 + NO_2$). Growth and yield responses can occur without classical injury symptoms and may occur without any appearance of foliar abnormalities. Complex interactions between air pollutants and both biotic and abiotic environmental factors also occur.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 35734, 35765, 35833, 35870, 35874, 35875, 36347, 37676, 37719, 37720, 37721, 37722, 37723, 37785, 37833, 37834, 37927, 37930, 38016, 38893

37763 (BMU—1987-160) Radio/ecological studies on the air-soil-vine-wine food chain. 4. interim report. Wagner, A. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.). Zentrallaboratorium fuer Isotopentechnik). 1987. 100p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen,, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The report summarizes the results of the first three years (1983-85) of the radio-ecological studies on wine which were performed on eight sites from major German wine-growing regions involving red and white wine varieties typical of their region. The radionuclides of tritium, carbon 14, strontium 90, cesium 137, radium 226 and sodium 40 were examined for their contents and presence in the food chain of air-soil-vine-wine in order to determine the pollution situation in grapes and wine and to gain information on their behaviour in the food chain. A number of soil parameters important for nutrient uptake were determined to describe the site.

37764 (CONF-880631—2) Analysis of radiological survey data to determine contaminated waste volumes. Yu, Charley. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009960/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

A procedure was developed to analyze radiological survey data from a contaminated material that has to be cleaned up or removed before the site can be released for unrestricted use. This procedure was coded in a FORTRAN computer program, RADVOL. The survey data are analyzed statistically by averaging over an area of 100 $m_3$and a depth of 0.15 m; the Kσ error is used to calculate the net count rate, where K depends on the confidence level required. The net count rates are converted to radionuclide concentrations and compared with the residual radioactive material guidelines to determine if the block (100 m_3 {times} 0.15 m volume) is contaminated (above guidelines). The analytical results are plotted three-dimensionally, which perspectively illustrates the contamination level of each block. This procedure was tested by using radiological survey data from an actual site contaminated with radium. The results indicate that this procedure is easy to use and can be applied to those sites where radiological survey data are available. The uncertainties in the procedure are also discussed.

37765 (DOE/NV/10327—30) Operation charioteer - onsite radiological safety report for announced nuclear tests, October 1985-September 1986. Mullen, O.W.; Eubank, B.F. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Jun 1988. Contract AC08-84NV10327. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88011878/JAW.

Charioteer was the name assigned to the series of underground nuclear experiments conducted at the Nevada Test Site from October 1, 1985 through September 30, 1986. This report includes those experiments publicly announced. Remote radiation measurements were taken during and after each nuclear experiment by a telemetry system. Monitors with portable radiation detection instruments surveyed reentry routes into ground zeros before other planned entries were made. Continuous surveillance was provided while personnel were in radiation areas and appropriate precautions were taken to protect persons from unnecessary exposure to radiation and toxic gases. Protective clothing and equipment were issued as needed. Complete radiological safety and industrial hygiene coverage were provided during drilling and mineback operations. Telemetered and portable radiation detector measurements

are listed. Detection instrumentation used is described and specific operational procedures are defined.

37766 **(DPST—88-256) Identification of stress areas associated with H- and F-area seepage basins using high-hesolution aircraft MSS [Multispectral Scanner] data for April 1987.** Jensen, J.R.; Mackey, H.E. Jr. (South Carolina Univ., Columbia (USA). Dept. of Geography; Savannah River Lab., Aiken, SC (USA)). Feb 1988. Contract AC09-76SR00001. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008214/JAW.

The F- and H-Area seepage basins located on the Savannah River Plant (SRP) have been in operation since the mid-1950's for the handling of wastes from the nuclear separation facilities. The H-Area seepage basins are located on the central portion of the SRP between Upper Three Runs Creek and Four Mile Creek. The H-Area seepage basins receive liquid waste containing low-level radioactivity and chemicals. The four H-Area basins cover an area of approxiamtely 5.6 {times} 10^4 m^2. Although senesced vegetation was identified in the pine and hardwood vegetation stands using the high resolution multispectral scanner (MSS) data and the unsupervised digital image processing techniques described, the agent(s) responsible for the stress are not known at this time. Therefore, these results identify vegetated areas that have experienced some senescence due to unknown factors. It appears that the H-Area seepage basins have produced a sizeable "question mark" shaped stress area just south of basin 4. The location of the stressed area lies in the same downgradient area as the high nitrate concentrations. An area along Four Mile Creek exhibited stress characteristics. Upland from the H-Area basins the vegetation is also stressed. Some of these areas were used as borrow pits in the past resulting in nutrient depleted soils. 7 refs., 10 figs.

37767 **(FERMILAB—88/40) Site environmental report for calendar year 1987.** Baker, S.I. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 May 1988. Contract AC02-76CH03000. 69p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010978/JAW.

Fermilab conducted a full year of high-energy physics research in CY-1987. The colliding beam physics program began in early January and extended into May. During the colliding beams run a total of 54 curies (Ci) of ^{11}C, ^{13}N, and ^{41}Ar were released from the Antiproton Source stack. During the fixed target program a total of 27 curies of radioactive gas, primarily ^{11}C, were released from the Neutrino Area stack. There was a negligible exposure from penetrating radiation during the colliding beams experiments; however, muons from the new Muon Laboratory gave a maximum site boundary potential exposure equal to the highest previous annual potential exposure which occurred in 1976. This result gave a total potential radiation exposure of 13 millirem (mrem) at the site boundary during CY-1987 compared to an average of 3.3 mrem per year for the previous years. The total potential radiation exposure to the general off-site population from Fermilab operations during CY-1987 was 5.3 person-rem, or about twice the average of 2.4 person-rem per year from previous operations. Since the exposure is from penetrating radiation, the 50 year dose commitment from operations in 1987 will be the same as the exposure received in 1987. The total release of airborne radioactivity was 81 Ci from venting of air containing short half-life radionuclides. The off-site release of tritium surface water totaled approximately 266 mCi. 43 refs., 11 figs., 10 tabs.

37768 **(GEPP-EM—1114) 1987 Pinellas Plant environmental monitoring report: Environmental health and safety programs.** (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). Apr 1988. Contract AC04-76DP00656. 43p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010334/JAW.

The effluent and environmental monitoring programs maintained by the Pinellas Plant are designed to determine the efficiencies of treatment and control mechanisms for environmental releases, provide measurements of discharge concentrations for comparison with applicable standards, assess the concentrations of these discharges in the on-site environment, and provide a data base for computer programs to calculate the potential dose to the public resulting from the operation of the Pinellas Plant. In 1987, as in previous years, the environmental effects of radiological and nonradiological effluents from the operation of the Pinellas Plant have been demonstrated to be insignificant. 21 refs., 1 fig., 6 tabs.

37769 **(INIS-mf—11133) Manual for the sampling of uranium mine tailings.** Feenstra, S.; Reades, D.W.; Cherry, J.A.; Chambers, D.B.; Case, G.G.; Ibbotson, B.G. (Golder Associates, Toronto, Ontario (Canada)). Apr 1983. 179p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702091/JAW.

Report to Energy, Mines and Resources Canada.

The purpose of this manual is to describe the requisite sampling procedures to provide a basis for the application of uniform high-quality standards to detailed geotechnical, hydrogeological, geochemical and air quality measurements at Canadian uranium tailings disposal sites. The report describes the objective and scope of a sampling program, the preliminary data collection, and the procedures for sampling of tailings solids, surface water and seepage, tailings porewater, and wind-blown dust and radon.

37770 **(ISH—96) Applicability and reliability of the 'observed ratio' model as a means of describing the strontium and the cesium transfer from soil to plant.** Leising, C. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Dec 1986. 89p. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

The report examines the suitability of the observed ratio, (OR), model as a means of describing the soil-to-plant transfer of cesium and strontium, and the reliability of results determined by this model. Literature studies have been made and are reported in order to show the discrimination between Sr and Ca, or Cs and K, respectively, and in order to show the magnitude of the OR value and the range of values it may cover. For the evaluation of results, care has been taken that only the physiologically relevant constituents of Sr, Ca, Cs, and K concentrations in the soil are taken into account, which are the water-soluble and the adsorptively bound forms. Non-mobile forms cannot be taken up by the plant and therefore are not considered in the model. In accordance with the literature reviewed, the report also differentiates between two experimental approaches: (1) hydroponics, and (2) greenhouse or field experiments.

37771 **(KFK—4311) Radioactivity in forests and single trees caused by the Chernobyl reactor accident.** Koenig, L.A.; Fessler, H.; Hempelmann, S.; Milbich-Muenzer, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Dec 1987. 26p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753388/JAW.

The activity deposited per km^2 in the Karlsruhe region is comparable with the sum of aerosols released from all nuclear power plants in the Federal Republic of Germany. Results of measurements performed in 1986 on leaf and needle samples are compared to the corresponding results obtained in 1987. The behavior of cesium activity in trees is discussed. In addition the results of measurements made in 1987 on small vegetation, especially mushrooms, are indicated. The Cs-activity expected to be found in the meat of deer of the same region is estimated.

37772 **(ORNL/M—556) Statement of work for the assessment of ambient environmental monitoring programs for the installations operated by Martin Marietta Energy Systems, Inc., at Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio.** Rogers, J.G. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Jun 1988. Contract AC05-84OR21400. 47p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011093/JAW.

This report describes a review of the ambient environmental monitoring programs at the five Department of Energy installations for compliance and consistency with DOE and Energy Systems policies and strategies, DOE Orders, environmental laws and regulations, and the current best monitoring practices. The scope of the assessment shall include the ambient air, water, groundwater, biological, and radiological environmental monitoring performed near

plant perimeter fences, in receiving streams, and at off-site locations. The scope of this task does not include assessing the on-site point source emission monitoring associated with specific stack sampling locations. It does not include specific National Pollutant Discharge Elimination System (NPDES) water monitoring and biological monitoring locations, nor does it include on-site groundwater monitoring locations. The scope of the assessment shall include the ambient air monitoring programs at each site and off-site; the surface water monitoring programs; and the off-site programs associated with the sampling of fish, wildlife, milk, groundwater, soil, vegetation, and stream sediments. Both radiological and nonradiological parameters should be reviewed and evaluated. The current monitoring locations should be evaluated to ensure that they are the appropriate locations to provide usable and defensible data. The current monitoring location to be evaluated at each site are shown in the tables included in this SOW. Also, the current parameters and sampling frequencies must be evaluated for adequacy. The tables outline the current ambient monitoring programs at each installation. 32 figs., 12 tabs.

37773 **(PNL-SA—15721) Modeling the dynamics of long-term cycling and storage of ^{137}Cs in forested ecosystems.** Van Voris, P.; Cowan, C.E.; Cataldo, D.A.; Wildung, R.E.; Shugart, H.H. (Pacific Northwest Lab., Richland, WA (USA); Virginia Univ., Charlottesville (USA)). Apr 1988. Contract AC06-76RL01830. 23p. (CONF-880367—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009487/JAW.

From SCOPE-ENUWAR workshop on the environmental consequences of nuclear war; Moscow, USSR (20 Mar 1988).

A microcomputer digital simulation model (RADFORET) was developed to predict the long-term ({approximately}250 years) cycling of radiocesium in forested ecosystems using detailed ^{137}Cs distribution data from two ecosystems. The primary forcing functions for the model were the concentration of^{137}Cs in the soil compartment and the rate of forest growth. Parameters were set for controlling the movement of ^{137}Cs from soil into, and the subsequent cycling within, the biotic compartments of the model for each ecosystem. The amount of the ^{137}Cs available for uptake from the soil was inversely correlated with the clay content in the soil from each site and was positively correlated with cation exchange capacity (CEC) and soil organic matter. The effect of forest growth as a forcing function in the ^{137}Cs cycling model was stimulated by coupling the output of a microcomputer digital simulation forest growth sucession model (FORET) to the cycling model. Thus, the radiocesium concentration in each of the seven compartments of the model resulted from both the donor-controlled linear differential equation model of radiocesium concentration in the soil and the dynamics of forest biomass over time. Forecasts of ^{137}Cs distribution in the donor-controlled model favorably compared with actual ^{137}Cs distribution in forests at Oak Ridge, Tennessee, and Savannah River, Georgia. This comparsion provided a measure of model validity for additional simulations of projected radiocesium cycling in the forests around the Chernobyl nuclear reactor accident site in the USSR.

37774 **(RHO-RE-SA—191-P) Transuranic measurements for in situ vitrification.** Subrahmanyam, V.B. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). May 1987. Contract AC06-77RL01030. 44p. (CONF-880601—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE87009333/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Radioactivity in soil below the crib 216-Z-12 in 200 West Area of Hanford was characterized. Four collinear wells in East-West direction were drilled for this investigation. Soil samples from different locations of three cores from 18 to 28 feet depths were analyzed. Actinides, ^{241}Am, ^{239}Pu, and ^{237}U and fission products ^{154}Eu and ^{137}Cs were detected in a well-defined narrow layer (<2 feet) at the crib bottom. Spatial distribution of activity and moisture content were also investigated. The major component of observed radioactivity was due to transuranium isotopes, with three to four orders of magnitude lower activity from the other nuclides. The maximum detected specific activity of 3000 +- 300 nCig may represent the retention capacity of the soil. The highest activity position varied in depth from 20.5 to 22.6 feet with higher activity occurring at deeper locations away in both directions from the effluent discharge pipe. The full width at half maximum (FWHM) activity was 0.2 foot in the western well and increased gradually to 1.2 feet in the eastern well. The activity layer in the investigated vertical plane could be represented by average values, for specific activity and FWHM, respectively, of 3000 nCig and 0.82 foot. 14 refs., 9 figs.

37775 **(STUK-A—54) Studies on environmental radioactivity in Finland 1984-1985. Annual report.** (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Mar 1987. vp. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780083/JAW.

Individual papers are included in the data bases. (psb)

5104 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 37841

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 35601, 35770, 35956, 37713, 37729, 38014, 38168

37776 **(DOE/EA—0291) Environmental assessment: Warren Air Force Base 115-kV transmission line, Cheyenne, Wyoming.** (USDOE Western Area Power Administration, Washington, DC). Mar 1986. 47p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008871/JAW.

The Western Area Power Administration (Western), is propsoing to construct a new electrical tranmission line and substation in southeastern Wyoming. This proposed line, called the Warren Air Force Base Tranmission Line, will supply power for Western's system to Francis E.Warren Air Force Base (F.E. Warren AFB) near Cheyenne. It would allow for increased tranmission capacity to the air base. F.E. Warren AFB currently is served electrically be Western via a 13.8-kv line. It is a wood-pole, double-circuit line without an overhead ground wire, which extends from Western's Cheyenne Substation, through an urban area, and onto the air base. The Cheyenne Substation is located on the south side of the city of Cheyenne. The electrical load on the base is increasing from 4 megawatts (MW) to 11 or 12 MW, an approximate three-fold increase. Voltage problems occasionally occur at the base due to the present electrial loads and to the age and inadequacy of the 13.8-kv line, which was placed in service in 1941. The existing line has served beyond its designed service life and requires replacement. Replacement would be necessary even without an increasing load. F.E. Warren AFB has several new and expanding programs, including additional housing, shopping centers, and the Peacekeeper Missile Program. Part of this expansion already has occured; the remainder is expected by early 1988. This expansion has created the need for additional electrical service. The present 13.8-kV line is not capable of supporting the additional load. 28 refs., 4 figs., 2 tabs.

37777 **(DOE/EIS—0107-F) Mead-Phoenix +-500 kV DC transmission line project: Final environmental impact statement.** (USDOE, Washington, DC). Feb 1986. 67p. NTIS, PC A04;3. Order Number DE88011477/JAW.

This environmental impact statement (EIS) assesses the environmental effects of Western Area Power Administration's (Western), Salt River Project's, Southern California Public Power Authority's, and Modesto-Santa Clara-Redding Public Power Agency's (MSR) proposal to construct, operate, and maintain a +-500-kV direct current (DC) transmission line from the proposed Eastwing Terminal near Phoenix, Arizona, to the Mead Substation near Boulder City, Nevada. The Mead-Phoenix transmission system will initially be designed to transfer 1600 megawatts (MW) between the Phoenix area and southern Nevada, with ultimate capacity of up to 2200 MW. Alternatives assessed include routing, design, and system alternatives. 1 fig., 4 tabs.

37778 (DOE/EIS—0116-FS) Blue River-Gore Pass portion of the Hayden-Blue River transmission line project, Grand and Summit Counties, Colorado: Final supplemental environmental impact statement. (USDOE Western Area Power Administration, Washington, DC). 1986. 209p. NTIS, PC A10;3. Order Number DE88011450/JAW.

This environmental impact statement (EIS) assesses the environmental effects of constructing, operating, and maintaining about 30 miles of 230/345-kV transmission line between the existing Gore Pass Substation northwest of Kremmling, Colorado, and a proposed new substation (not part of this action) near the Ute Pass Road. The action includes minor work at the Gore Pass Substation and two taps, and also the removal of two existing transmission lines; a 69-kV line between Gore Pass Substation and Green Mountain Power Plant and a 115-kV line between Green Mountain Power Plant and Blue River Tap. The purpose of the project is to provide additional transmission capacity onto the areas of Gore Pass, Granby, Green Mountain, Dillon, Climax, Oak Creek, and Keystone, and between the generation plants in western Colorado and the major load areas in eastern Colorado. Alternatives assessed include routing and design alternatives plus the alternatives addressed in the Hayden-Blue River Final EIS, issued by the Rural Electrification Administration in July, 1982. 24 figs., 14 tabs.

37779 (DOE/EIS—0125-F) Intertie development and use: Final environmental impact statement: Volume 2, Comments and responses. (Bonneville Power Administration, Portland, OR (USA)). Apr 1988. 230p. NTIS, PC A11;3. Order Number DE88011481/JAW.

This environmental impact statement examines the environmental effects of three proposed Bonneville Power Administration actions with respect to the use and development of the Pacific Northwest/Pacific Southwest Intertie. The actions are: expansion of the capacity of the Intertie; adoption of a Long-Term Intertie Access Policy (IAP), which will set the ground rules for use of the Intertie by utilities other than BPA for short and long-term transmission of surplus power to California; and decisions by BPA to enable, through its access policies and marketing efforts, various types and levels of firm power marketing between the Northwest and California. BPA is proposing these actions in order to make possible additional short and long-term sales of Federal power surplus to that needed for serving Northwest loads and to increase the ability to deliver surplus power when the surplus is most valuable to the importing region. Additionally, the actions are needed to increase economic efficiency, to support environmental quality goals, and to enhance the ability of BPA to repay its US Treasury investment in a timely fashion while maintaining reasonable power rates for its wholesale customers in the Northwest. There is a need for an equitable procedure to allocate access to Intertie capacity that is excess to what BPA requires for its own use and to provide opportunities for assured access to make possible long-term firm power transactions by utilities other than BPA. Volume 2 contains public comments to the proposed actions.

37780 (DOE/EIS—0125-F) Intertie development and use: Final environmental impact statement: Volume 3, Comment letters. (Bonneville Power Administration, Portland, OR (USA)). Apr 1988. 1125p. NTIS, PC A99;3. Order Number DE88011479/JAW.

The Intertie Development and Use (IDU) Final Environmental Impact Statement (EIS) examines the environmental effects of three proposed Bonneville Power Administration (BPA) actions with respect to the use and development of the Pacific Northwest/Pacific Southeast intertie; adoption of a Long-Term Intertie Access Policy (IAP), which will set the ground rules for use of the Intertie by utilities other than BPA for short-and-long transmission of surplus power to California; and decisions by BPA to enable, through its access policies and marketing efforts, various types and levels of firm power marketing between the Northwest and California. Volume 3 contains letters reacting to the draft environmental impact statement.

37781 (DOE/ID—12584-20) Background concentrations of selected elements in unconsolidated surficial materials at the US Department of Energy, Kansas City Facility. Fleischhauer, H.L. (UNC Geotech, Grand Junction, CO (USA)). Feb 1988. Contract AC07-86ID12584. 88p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010902/JAW.

A comprehensive hydrogeologic site characterization is being conducted at the US Department of Energy Facility in Kansas City, Missouri. The investigation was prompted initially by the discovery of volatile organic compounds in groundwater at the Tank Farm, an area where a number of underground storage tanks are located. The study has expanded to include other areas of the Facility such as landfills, surface inpoundments, spill sites, and storm sewer systems. The site characterization will characterize the site geology; define and model the groundwater flow to predict migration of contaminants; and define the extent of soil contamination in areas of known spills, leaks, and landfills. Contamination in surface soils was initially investigated in a reconnaissance survey conducted in 1984. Background concentrations of eight elements were estimated from the results obtained in this survey (Korte and others, 1985). As the site characterization has progressed, a considerable number of inorganic analyses have been performed on soils and other unconsolidated material collected at various sites on the facility. To date, 273 samples have been collected and more than 2000 analytical determinations have been performed for a suite of 10 elements. These elements are arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc. 41 refs., 18 figs., 31 tabs.

37782 (DP—1739-6) Comprehensive Cooling Water Study: Volume 6, Federally endangered species, Savannah River Plant: Final report. Mackey, H.E. (ed.). (Savannah River Lab., Aiken, SC (USA)). Sep 1987. Contract AC09-76SR00001. 192p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88010406/JAW.

The Comprehensive Cooling Water Study (CCWS) was initiated in 1983 to evaluate the environmental effects of the intake and release of cooling water on the structure and function of aquatic ecosystems at the Savannah River Plant. The initial report described the results from the first year of the study. This document is the final report and concludes the program. The report comprises eight volumes. The Endangered Species Act requires that Federal agencies use their authorities to conduct programs for the conservation of endangered and threatened species and to ensure that agency actions do not jeopardize the continued existence of or result in the destruction or adverse modification of critical habitat of protected species. Those Federally endangered or threatened species that occur on the Savannah River Plant (SRP) include the American alligator, the red-cockaded woodpecker, the shortnose sturgeon, the wood stork, and the bald eagle. Of these species, the alligator, sturgeon, wood stork, and the bald eagle are likely to be affected directly and/or indirectly by the intake or release of cooling water at the SRP. 81 refs., 76 figs., 35 tabs.

37783 (EUR—10861) Advanced decision-oriented software for the management of hazardous substances. A survey of software and sources of information. Fedra, K.; Schneider, J.; Ditterich, K. (Commission of the European Communities, Luxembourg). 1987. 64p. Commission of the European Communities, Luxembourg.

This report is carried out together with IIASA's outreach activities project on dialoguing with decision-makers on the management of industrial risk. It is supported by Unesco's Man and the biosphere programme. The objective is to design and develop an integrated set of software tools, adapted even for non-technical users. The report is a state-of-the-art survey including: (i) categories of hazardous substances, (ii) lists of hazardous substances and the industries releasing this waste, (iii) institutions, regulations and directives, (iv) data bases and a collection of models, (v) methods for comprehensive assessments, etc. It is therefore aimed to provide tools for decision making, usable by those engaged in the management of the environment and of industrial products and residues.

37784 **(GAO/RCED—86-107) National parks: Emergency law enforcement expenditures at two recreation areas.** (General Accounting Office, Washington, DC (USA)). 1986. 8p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The National Park Service is using congressionally approved funds from other approved budget areas for law enforcement activities. GAO is concerned that this funding approach works against efforts in the construction, land acquisition, and other Park Service appropriation areas from which the emergency law enforcement funds were obtained. This occurrence, at Gateway, New York, and Golden Gate, California, National Recreation Areas, is inconsistent with the Park Service's emergency law enforcement expenditure authority.

37785 **(ORNL/CSD/TM—226) Review of geographic processing techniques applicable to regional analysis.** Durfee, R.C. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 131p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88010759/JAW.

Since the early 1970s regional environmental studies have been carried out at the Oak Ridge National Laboratory using computer-assisted techniques. This paper presents an overview of some of these past experiences and the capabilities developed at the Laboratory for processing, analyzing, and displaying geographic data. A variety of technologies have resulted such as computer cartography, image processing, spatial modeling, computer graphics, data base management, and geographic information systems. These tools have been used in a wide range of spatial applications involving facility siting, transportation routing, coal resource analysis, environmental impacts, terrain modeling, inventory development, demographic studies, water resource analyses, etc. The report discusses a number of topics dealing with geographic data bases and structures, software and processing techniques, hardware systems, models and analysis tools, data acquisition techniques, and graphical display methods. Numerous results from many different applications are shown to aid the reader interested in using geographic information systems for environmental analyses. 15 refs., 64 figs., 2 tabs.

5106 Regulations

REFER ALSO TO CITATION(S) 36486, 36487, 37730, 37731, 37850

37786 **(PB—88-195672/XAB) Alternative-treatment methods for hazardous wastes.** Dial, C.J. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Apr 1988. 17p. (EPA—600/D-88/061). NTIS, PC A03/MF A01.

The five-year schedule for the minimization and restrictions on the disposal of hazardous wastes onto the land is described. Two major items are causing a shift in the way hazardous wastes are managed in the United States. Because of liability for hazardous wastes, companies are seeking that which will detoxify or destroy these wastes. Under the RCRA amendments, best demonstrated available technology (BDAT) is being determined for each waste stream and is considered here. A description of the types of wastes not readily treated by current technologies and some of the deficiencies of these technologies are covered. Technologies currently used in the Superfund Innovative Technology Evaluation (SITE) Program are described.

37787 **(PB—88-197595/XAB) Standards applicable to owners and operators of hazardous-waste treatment, storage, and disposal facilities under RCRA (Resource Conservation and Recovery Act), Subtitle C, Section 3004. Financial requirements: interim status standards (40 CFR 265, Subpart H) (with addendum).** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 1984. 185p. (EPA—530/SW-913). NTIS, PC A09/MF A01.

See also PB—81-189326; Portions of this document are not fully legible.

This guidance manual was developed to accompany the May 19, 1980 Subpart H cost estimating interim status regulations and their technical amendments. Since the manual was prepared, additional Subpart G regulations which affect the cost-estimating requirements were promulgated. Therefore, the manual does not necessarily reflect all the current requirements. The Agency is planning to update the manual to incorporate these additional requirements. In the meantime, however, an addendum included in the manual to clarify several points. The manual is intended to serve as a guide to the types of cost categories and documentation that are appropriate to include in a closure and post-closure care cost estimate. The sample estimates contained in the document illustrate the format and level of detail that would be acceptable to the U.S. Environmental Protection Agency.

52 ENVIRONMENTAL SCIENCES, AQUATIC

37788 **(BNL—40980) Approaches for identifying, characterizing and managing risks from accidentally released toxic gases.** Moskowitz, P.D.; Fthenakis, V.M.; Morris, S.C.; Hamilton, L.D. (Brookhaven National Lab., Upton, NY (USA)). Oct 1987. Contract AC02-76CH00016. 18p. (CONF-8710301—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007752/JAW.

From Hazard assessment and control technology in semiconductor manufacturing meeting; Cincinnati, OH, USA (21 Oct 1987).

Accidental releases of toxic gases used by in semiconductor device and photovoltaic cell manufacturre and in other industries may present hazards to occupational or public health. Identification of consequences associated with such releases and characterization of accident-initiating events requires detailed and systematic evaluation. Many approaches are available to the semiconductor and photovoltaics industry to identify, characterize and manage risks from toxic gases. Application of these approaches may require simple data collection activities or complex evaluation efforts. The more complex efforts should only be initiated when screening efforts have shown that the activity of interest can present a significant hazard to life or property. Application of these approaches throughout the design and operation of these facilities, can improve plant safety. 16 refs., 3 figs., 2 tabs.

5201 Basic Studies

REFER ALSO TO CITATION(S) 36993

37789 **(AD-A—189968/1/XAB) Wetlands Research Program. Wetland Evaluation Technique (WET). Volume 2. Methodology. Operational draft report.** Adamus, P.R.; Clairain, E.J.; Smith, D.; Young, R.E. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Oct 1987. 262p. NTIS, PC A12/MF A01.

This manual outlines a Wetland Evaluation Technique (WET) for the assessment of wetland functions and values. WET is a revision of the method developed for the Federal Highway administration (FHWA) that has often been referred to as the Federal Highway Method or the Adamus Method . Wetland functions are the physical, chemical, and biological characteristics of a wetland. WET evaluates the following functions and values: ground-water stabilization, sediment/toxicant retention, nutrient removal/transformation, production export, wildlife diversity/abundance, aquatic diversity/abundance, uniqueness/heritage, and recreation. WET evaluates functions and values in terms of social significance, effectiveness, and opportunity. Social significance assesses the value of a wetland to society in terms of its special designations, potential economic value, and strategic location. Effectiveness assesses the capability of a wetland to perform a function because of its physical, chemical, or biological characteristics. Opportunity assesses the opportunity of a wetland to perform a function to its level of capability. WET was designed primarily for conducting an initial, rapid assessment of wetland functions and values.

37790 (BR—82(11.80)) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic): Sandworm and bloodworm. Wilson, W.H., Jr.; Ruff, R.E.; Moran, D. (Manomet Bird Observatory, MA (USA); Fish and Wildlife Service, Slidell, LA (USA); Corps of Engineers, Vicksburg, MS (USA). Waterways Experiment Station; Fish and Wildlife Service, Washington, DC (USA)). Apr 1988. 31p. (TR-EL—82-4). US Fish and Wildlife Service, 1010 Gause Blvd., Slidell, LA 70548. Order Number TI88010179/JAW.

Species profiles are literature summaries of the taxonomy, morphology, range, life history, and environmental requirements of coastal aquatic species. They are prepared to assist in environmental impact assessment. The sandworm (Nereis virens) is a commercially valuable baitworm, reaching lengths of 30 cm. Most worms live 4 or 5 years. Males swarm in the water column before spawning in the females' burrows. Both males and females die after spawning. A planktonic larval phase is either brief or lacking. Sandworms are omnivorous. They can significantly reduce the abundance of smaller infaunal organisms. Predators on sandworms include bloodworms and gulls. Physiological tolerances are broad although most worms are found in fine sand with water of high salinity. Sandworms have been the subject of much toxicological research and readily adapt to laboratory conditions. The bloodworm (Glycera dibranchiata), attaining lengths of 40 cm, is also an important baitworm. Its maximum life span is 5 years. Spawning occurs in the water column with both males and females dying after spawning. Bloodworms are primarily predators, preying on certain species of polychaetes and crustaceans, although they are capable of digesting detritus. Bloodworms appear to have few predators. Bloodworms possess at least two types of hemoglobin, permitting them to tolerate a wide range of oxygen tensions. 177 refs., 4 figs.

37791 (BR—82(11.81)) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest): Chum salmon. Pauley, G.B.; Bowers, K.L.; Thomas, G.L. (Washington Univ., Seattle (USA). Cooperative Fishery Research Unit; Fish and Wildlife Service, Slidell, LA (USA). National Wetlands Research Center). Mar 1988. 17p. (TR-EL—82-4). US Fish and Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458. Order Number TI88009313/JAW.

Chum salmon are anadromous fish found throughout a large part of the North Pacific Ocean and are the most widely distributed of all the Pacific salmon. Adults return to spawn in late summer and fall. Young fish migrate downstream quickly and rear in estuaries. Chum salmon mature later in life in more northerly water: in Alaska and British Columbia at age 4 to 5, in Washington and Oregon at age 3 to age 4. Fish from larger river systems grow to the largest size. The major commercial fishery is centered in Southeast Alaska and British Columbia. Harvest has increased in Washington to 1,150,000 fish annually due to increased hatchery production, with Hood Canal rivers accounting for 25% of all Washington fish. In odd-numbered years, the adult return-to-escapement ratio in any given river system is positively statistically correlated with increased spawning escapement of chum salmon relative to that of pink salmon.

37792 (CEA-CONF—9217) Oceanic tritium/helium pair analysis by mass spectrometry. Jean-Baptiste, P.; Andrie, C.; Lelu, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 11p. (In French). (CONF-870627—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753453/JAW.

From International symposium on radioactivity and oceanography; Cherbourg, France (2 Jun 1987).

We describe the experimental procedure of the mass spectrometric measurements of the dissolved helium isotopes (^{3}He and ^{4}He) in seawater and the analytical method of the oceanic tritium determination by the β-regrowth technique. The experimental procedures and the analytical accuracies of each method are reported. Finally, the interest of the helium-3tritium pair is emphazised through the determination of a water mass age.

37793 (CEA-CONF—9218) Use of tritium and helium-3 for oceanographic processes study. An example: the Northeastern Atlantic Ocean. Andrie, C.; Merlivat, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 12p. (CONF-870627—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780088/JAW.

From International symposium on radioactivity and oceanography; Cherbourg, France (2 Jun 1987).

These results are relative to the TOPOGULF cruise during summer 1983. The sampled area is located near the Azores Islands on the both sides of the mid atlantic ridge. The tritium content of the surface waters reveals a strong front along the Azores current. At depth, the spatial distribution of tritium is studied along isopycnals. In the thermocline, it is essentially the anticyclonic gyre which is responsible for the northeast - southwest gradient in tritium concentration. Some informations about the age of the water masses are given by the use of both tritium and Helium-3. By this way are identified some areas where ventilation processes are active. At middepth, a strong contrast exists between the young waters originating from the Labrador Sea and the more stagnant waters in the South East of the sampled area.

37794 (DOE/NE—60570-1) Reduce uncertainty in projection of future sea-level changes due to ice wastage: Annual performance report. Meier, M.F.; Illangesakare, T.; Pfeffer, T.; Walter, R. Jr.; Kaufman, D. (Colorado Univ., Boulder (USA)). 1988. Contract FG02-87ER60570. 8p. NTIS, PC A02;3. Order Number DE88009883/JAW.

This is the first year of a three-year grant, and efforts during the first year were concentrated on literature search, preliminary investigation of the physics and developments of first-generation numerical models of the movement of water through cold snow, development of some necessary instrumentation, the first phase of a field experiment on the infiltration of water into cold snow in Arctic Canada, and the beginning of a field investigation on runoff processes in the marginal area of the Greenland Ice Sheet.

37795 (PB—88-190756/XAB) National Surface Water Survey, Western Lake Survey (Phase 1 - synoptic chemistry) quality assurance report. Silverstein, M.E.; Faber, M.L.; Drouse, S.K.; Mitchell-Hall, T.E. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Nov 1987. 312p. NTIS, PC A14/MF A01.

See also PB—87-234928.

The quality-assurance program for the Western Lake Survey - Phase I was designed to ensure that the data collected were of known and acceptable quality. The quality-assurance program was based on similar activities conducted for the Eastern Lake Survey; - Phase I, and included the following major elements: selection of analytical laboratories, training of field sampling and field laboratory crews, on-site evaluation of field operations and analytical laboratories, daily communications with survey participants, and verification and evaluation of data collected. Quality assurance and quality control samples were used to identify, qualify, and quantify sources of sampling and analytical variability in terms of precision, accuracy, bias, and detectability. The relative importance of these sources of variation was assessed statistically.

37796 (PB—88-195359/XAB) Review of information bearing upon the conservation and protection of humpback whales in hawaii. Final report. Tinney, R.T. (Tinney (Richard T.), Jr., Arlington, VA (USA)). Mar 1988. 65p. NTIS, PC A04/MF A01.

See also PB—85-200772.

Humpback whales wintering in Hawaii may be affected by human activities in the nearshore waters apparently favored by the whales. The report reviews available information on the number, age/sex composition, reproductive status, distribution, movements, and essential habitats of the whales in Hawaii. It then identifies human activities that may be affecting the whales or their habitats and describes their nature, magnitude, and significance. This is followed by: a review of existing local, state, and Federal laws and regulations and their adequacy for avoiding or mitigating the effects of human activities on the whales; an identification of critical information gaps regarding the whales and the human activities.

37797 **(PB—88-863493/XAB) Microbiology of ground water. January 1978-April 1988 (Citations from the Life Sciences Collection data base). Report for January 1978-April 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 106p. NTIS PC N01/MF N01.

Supersedes PB—87-857892.

This bibliography contains citations concerning the occurrence, distribution, activity, and movement of ground-water microorganisms. Detection of microorganisms and their effects upon ground-water quality are also considered. (This updated bibliography contains 180 citations, 99 of which are new entries to the previous edition.)

37798 **(PNL-SA—15393) Reconnaissance survey of eight bays in Puget Sound.** Strand, J.A.; Crecelius, E.A.; Pearson, W.H.; Fellingham, G.W.; Elston, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 11p. (CONF-880374—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008186/JAW.

From 1. annual meeting on Puget Sound research; Seattle, WA, USA (18 Mar 1988).

From 1983 to 1985, Battelle/Marine Research Laboratory conducted reconnaissance-level field and laboratory studies to better characterize toxic contamination problems occurring in selected urban-industrialized bays (Bellingham Bay, Port Gardner - Everett Harbor, Fourmile Rock - Elliot Bay dump site vicinity, Sinclair Inlet) of Puget Sound. It was envisioned that this goal was best achieved by simultaneously determining levels of contamination in selected baseline or 'reference bays' (Samish Bay, Case Inlet, Dabob Bay, Sequim Bay). Two major tasks composed this effort. The first was conducted in 1983 and consisted of preliminary or screening surveys to collect and analyze sediment samples from 101 stations distributed in the four urban-industrialized bays (Figure 1), and at 80 stations distributed in the four baseline bays (Figure 2). The second task was undertaken in 1984 and involved detailed surveys and analyses of the same bays, but at a limited number of stations (32 in urban embayments, 16 in baseline bays). The stations to be resampled in 1984 were the "cleanest" of the clean and the "dirtiest" of the dirty as determined by the 1983 sediment chemical analyses, and within restrictions imposed by sediment type.

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REFER ALSO TO CITATION(S) 35686, 35692, 35762, 35965, 36648, 36652, 36653, 36671, 36679, 36993, 36997, 37002, 37048, 37653, 37676, 37685, 37714, 37720, 37722, 37724, 37742, 37744, 37747, 37756, 37757, 37760, 37768, 37772, 37781, 37785, 37795, 37797, 37840, 37852, 38020, 38021, 38130, 38132

37799 **(AD-A—190073/7/XAB) Water-quality assessment of DOD installations/facilities in the Chesapeake Bay Region. Phase 3. Volume 1. Summary. Technical report, 1985-1987.** (Tetra Tech, Inc., Arlington, VA (USA)). Nov 1987. 109p. NTIS, PC A06/MF A01.

See also Volume 2, AD-A190 074.

This report represents the culmination of a two-year, three-phase effort to determine the relative impact of DOD activities on the water quality and living resource of the Chesapeake Bay. Phase I defined the recent historical and present pollution potential of all 66 DOD installations in the Bay's drainage basin, and developed a preliminary screening procedure to categorize these installations according to existing or potential impacts on the Bay and its tributaries. Phase II developed and tested a detailed assessment methodology on six installations to define the character and extent of their impact on the Bay. Phase III applied this test-bed methodology to the remaining 31 installations identified in Phase I as needing more-detailed assessment, and summarizes impacts and program recommendations from an installation, regional, and Bay-wide perspective. This volume presents summary information from this analysis.

37800 **(AD-A—190074/5/XAB) Water-quality assessment of DOD installations/facilities in the Chesapeake Bay Region. Phase 3. Volume 2. Overall approach, findings and recommendations. Technical report, 1985-1987.** (Tetra Tech, Inc., Arlington, VA (USA)). Nov 1987. 507p. NTIS, PC A22/MF A01.

See also Volume 1, AD-A190 073.

This report represents the culmination of a two-year, three-phase effort to determine the relative impact of DOD activities on the water quality and living resources of the Chesapeake Bay. Phase I defined the recent historical and present pollution potential of all 66 DOD installations in the Bay's drainage basin, and developed a preliminary screening procedure to categorize these installations according to existing or potential impacts on the Bay and its tributaries. Phase II developed and tested a detailed assessment methodology on six installations to define the character and extent of their impact on the Bay. Phase III applied this tested methodology to the remaining 31 installations identified in Phase I as needing more detailed assessment, and summarizes impacts and program recommendations from an installation, regional, and Bay-wide perspective. This volume presents detailed results of this analysis.

37801 **(AD-A—190376/4/XAB) Economic evaluation of air stripping to remove volatile organic compounds from water. Final report.** Zaghloul, H.H.; Ball, R.O.; Maloney, S.W. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Dec 1987. 54p. (CERL-TR-N—87/23). NTIS, PC A04/MF A01.

This report documents the results of a study conducted to provide a basis for estimating the costs of installing and using air stripping to remove volatile organic compounds (VOCs) from water. The air-stripping technology was found to be a very economical and efficient method for contaminant removal. The technology is simple, relatively inexpensive to install, and has low labor and maintenance requirements. VOC removal rates range from 90 to 99.99%. Estimated costs, in terms of percentage of total production costs, were found to be 40% for capital costs, 50% for operational costs, and 10% for maintenance costs, according to literature sources. Results of a survey conducted during this study generally agree with these percentages, except that maintenance costs reported on the survey were lower due to the highly automated nature of new installations.

37802 **(AD-A—190441/6/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification, Stage 1. Air Force Plant 4, Fort Worth, Texas. Volume 1. Report text. Final report, September 1985-September 1986.** (Radian Corp., Austin, TX (USA)). Dec 1987. 465p. NTIS, PC A20/MF A01.

See also Volume 2, AD-A190 442.

The Department of Defense's Installation Restoration Program (IRP) is a four-phase program to identify past waste disposal practices, evaluate the environmental impacts, propose mitigation measures, and remediate environmental problems. An IRP investigation is currently underway at AF Plant 4, Texas. Phase I, an initial assessment and records search to locate potential environmental problems associated with waste-disposal practices, was completed in 1984. Phase II, a field program to investigate potential environmental contamination, has been under way since 1985 under the direction of the U.S. Air Force Occupational and Environmental Health Laboratory (USAFOEHL). Radian Corporation of Austin, Texas, has performed Stage 1 of the Phase II investigation which is reported in this document.

37803 **(AD-A—190443/2/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 4, Fort Worth, Texas. Volume 3. Appendix A-1 (continued). Final report, September 1985-September 1986.** (Radian Corp., Austin, TX (USA)). Dec 1987. 549p. NTIS, PC A23/MF A01.

See also Volume 4, AD-A190 444.

This report contains data concerning water quality and environmental protection. This report was prepared for the United States Air Force by Radian Corporation, for the purpose of aiding in the implementation of the Air Force Installation Restoration Program.

37804 **(AD-A—190444/0/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 4, Fort Worth, Texas. Volume 4. Appendix A-1 (continued). Final report, September 1985-September 1986.** (Radian Corp., Austin, TX (USA)). Dec 1987. 603p. NTIS, PC A99/MF A01.

See also Volume 5, AD-A190 445.

This report discusses analytical data concerning environmental protection and water quality. This report was prepared for the United States Air Force by Radian Corporation, for the purpose of aiding in the implementation of the Air Force Installation Restoration Program.

37805 **(AD-A—190445/7/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 4, Fort Worth, Texas. Volume 5. Appendix A-2. Final report, September 1985-September 1986.** (Radian Corp., Austin, TX (USA)). Dec 1987. 517p. NTIS, PC A22/MF A01.

See also Volume 6, AD-A190 446.

This report contains information concerning environmental protection and water quality. Volume 5 and Volume 6 contain all quality/assurance quality control reports for water analyses (organized by work order number). Also included are summary tables (Tables A.2-1 through A.2-9) of the QC reports.

37806 **(AD-A—190446/5/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 4, Fort Worth, Texas. Volume 6. Appendix A-2 (continued). Final report, September 1985-September 1986.** (Radian Corp., Austin, TX (USA)). Dec 1987. 492p. NTIS, PC A21/MF A01.

See also Volume 7, AD-A190 447.

This document discusses data concerning environmental protection and water quality. This report was prepared for the United States Air Force by Radian Corporation, for the purpose of aiding in the implementation of the Air Force Installation Restoration Program.

37807 **(AD-A—190450/7/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 4, Fort Worth, Texas. Volume 10. Appendix I. Final report, September 1985-September 1986.** (Radian Corp., Austin, TX (USA)). Dec 1987. 620p. NTIS, PC A99/MF A01.

See also Volume 1, AD-A190 441.

This appendix includes analytical data from past and ongoing studies performed by Hargis & Associates for General Dynamics. The groundwater-quality data complied by Hargis & Associates, and used for comparison in the IRP Phase II Study, are listed below by the report from which they were obtained. Phase II Investigation of Subsurface Condition, U.S. Air Force Plant No. 4, Fort Worth, Texas (1985). Appendixes H-K Table 1; Water Quality Data, May 1985 through May 1986, U.S. Air Force Plant No. 4 Fort Worth, Texas (1986); Appendices C, D, E, and G. This report contains data concerning environmental protection.

37808 **(CONF-880679—3) The trade off between the complexity, input data and scale of application of the RAINS-lake model: A statistical analysis.** Hettelingh, J.P.; Gardner, R.H. (Oak Ridge National Lab., TN (USA); International Inst. for Applied Systems Analysis, Laxenburg (Austria)). 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010134/JAW.

From 81. annual meeting of Air Pollution Control Association; Dallas, TX, USA (1 Jun 1988).

To use a complex, process-oriented site model for predicting broad-scale environmental effects assumes (1) the availability of a large, quality data base for calibrating the model and (2) the validity of the process of extrapolating site-specific results to a larger region. The greater the level of extrapolation, the more error prone the model results may become. A simplified version of a complex process oriented RAINS Lake Model (RLM) was developed by regression methods to quantify these extrapolation errors. RLM variables that explain more than 1% of the variation in the model output (pH of 1980) were selected and calibrated to the measured pH distribution in 1980 in the southern region of Finland from 1920 to 1980. An iterative procedure was then used to select the minimum number of variables which best represented the behavior of the RLM. The results show that extreme regional characteristics may necessitate adaptation of a simplified model that has been calibrated in a less extreme regional context. 22 refs., 5 figs., 3 tabs.

37809 **(CONF-8806114—1) Microchemical analysis of fish hard parts for reconstructing habitat use: Practice and promise.** Coutant, C.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 19p. (CONF-8806114—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009055/JAW.

From International symposium and educational workshop on fish-marking techniques; Seattle, WA, USA (27 Jun 1988).

This paper describes and evaluates the application of several microscale chemical analysis techniques that allow the chemical record imbedded in daily and seasonal growth banding of biological skeletal materials to be used as an indicator of habitat history. Electron microprobe techniques offer the ability to scan many elements simultaneously but with low quantitative resolution; this technique has been applied to fish tissues by several investigators. Laser-based techniques, which were developed at Oak Ridge National Laboratory for use in the physical sciences, offer extremely high spatial and quantitative resolution for elements or isotopes, but the elements must be analyzed one at a time. They include several forms of resonance ionization spectroscopy and laser-induced fluorescence. Applications envisioned for fisheries research include differentiating freshwater, saltwater, and estuarine habitation of migratory striped bass; chemically marking hatchery-raised fish; and determining the exposure history of fish to water pollutants. 42 refs.

37810 **(EGG-M—10287) The effect of acidophilic heterotrophic bacteria on the leaching of cobalt by Thiobacillus ferrooxidans.** Wichlacz, P.L.; Thompson, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 10p. (CONF-8707155—1). NTIS, PC A02/MF A01; GPO Dep. Order Number TI88007731/JAW.

From International biohydrometallurgy symposium; Warwick, UK (13 Jul 1987).

Experiments were conducted to determine if acidophilic heterotrophic bacteria influence the ability of T. ferrooxidans to solubilize cobalt. Short term (7 day) flask leaching studies were conducted wherein 28 strains of T. ferrooxidans were each incubated with one of three different cobalt sulfides (CoS, cobaltite flotation concentrate, or cobaltite ore), with and without ferrous iron and/or heterotrophic bacteria. Growth of T. ferrooxidans was determined by comparing cobalt solubilization and ferrous iron oxidation for inoculated and uninoculated control flasks. Under all conditions tested, except one, the addition of acidophilic heterotrophs was found to enhance the extent of cobalt leaching. Longer term (28 day) studies were conducted which included the addition of glucose as a controlled variable. The presence of heterotrophs enhanced the leaching of CoS by T. ferrooxidans under all conditions. Cobalt leaching from concentrate and high grade ore by T. ferrooxidans was enhanced by the addition of heterotrophs in all cases except when ferrous iron or glucose were absent from the leaching medium. The present studies indicate that cobalt solubilization is substrate and strain dependent and, in most cases, is increased when acidophilic heterotrophic bacteria are present. 13 refs., 3 tabs.

37811 **(EPRI-EA—5816) Evaluation of tracer sampling devices for the macrodispersion experiment.** Boggs, J.M.; Hemond, H.F. (Tennessee Valley Authority, Norris (USA). Office of Natural Resources and Economic Development; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Civil Engineering). May 1988. 91p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010688/JAW.

This report describes development and testing of multilevel sampling wells for the Macrodispersion Experiment (MADE). The objective was to assure that the wells used in the experiment provide representative groundwater tracer samples from discrete zones within the aquifer. Local tracer tests were conducted on several wells of different design to directly measure groundwater movement in the immediate vicinity of the sampling ports. Tests were

carried out to examine changes in natural groundwater flow patterns resulting from well installation and to evaluate interference between ports during sampling. Results indicated that an auger-installed multilevel sampler with external bentonite packers between sampling ports (AMLS-P) performed best. A drivable nultilevel sampler (DMLS) indicated about the same level of performance with respect to sampling port interference but showed evidence of changes in local groundwater movement in approximately half of the tests. The AMLS-P and DMLS were subsequently evaluated using tracer concentration and hydraulic head measurements during the first four months of the large-scale field tracer experiment. The AMLS-P and DMLS exhibited similar plume sampling and hydraulic head measurments. The AMLS-P was selected for future additions to the tracer sampling network because of its lower cost and better results for the local tracer tests. 9 refs., 21 figs., 4 tabs.

37812 **(GAO/RCED—87-170) Hazardous waste: Controls over injection well disposal operations.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 52p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

There have been few confirmed cases of drinking-water contamination from hazardous waste injection wells. However, because the contamination is hard to detect, it cannot be said with certainty that no other cases exist. Neither the Environmental Protection Agency nor the states require that groundwater immediately above injected waste be sampled and tested for contamination. In monitoring 21 wells in 2 states for which EPA has direct oversight responsibility, GAO found that the agency did not perform the required periodic inspections during FY 1985 and 1986. Effective in August 1988, underground hazardous waste injection will be banned except where it can be shown that the waste can be fully contained within the injection zone and will not spread into unintended areas; the burden of proof will fall on the well operator. EPA expects that, with few exception, wells operating today will be able to meet this test and will, therefore, continue to inject hazardous waste underground.

37813 **(GKSS—87/E/40) Results of mapping a groyne-field of the Elbe river near Schnakenbek.** Wilken, R.D.; Posske, G. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1987. 7p. (In German). Special print from Dtsch. Gewaesserkd. Mitt. (1987) v. 31(2/3) p. 77-81.

In a groyne-field of the Elbe river near Schnakenbek, at Elbe-km 575,3, measurements on sediment load and sediment distribution were conducted in September-October 1985. In some places of this zone a sediment thickness of more than 1,90 m was measured. (Discharge at that time: about 400 m^3s, average discharge: 751 m^3s). The total sediment load in the field was estimated at 5,700 m^3, corresponding to 6,000 tons (wet weight). If in other groyne-fields of the Elbe upstream of the Geesthacht weir similar conditions prevailed, an influence of the meanwhile deposited material on the suspended sediment transport could not be excluded. In consideration of contaminated dredged material this effect might be of importance for the sediment process in the Hamburg Harbour.

37814 **(IVL-B—846) Liming project Haerskogen 1976-1986. Water chemical and biologic response on liming in seven Westswedish lakes.** Alenaes, I. (Swedish Environmental Research Inst., Stockholm). 18 Dec 1986. 60p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752912/JAW.

This report describes a liming project where 2000 tons of limestone were spread in seven lakes at the Swedish westcoast. Six different limestone products and six different application techniques were tested. The overall results are very positive, though acid surges were documented. 50-95% of the applied limestone were dissolved during 1977-85. Fish reproduction improved and benthic invertebrates showed long-term expansion within and between lakes; valuable knowledge to be used in future designing of biologically applied liming strategies.

37815 **(LBL—24250) Hydrological, geochemical, and ecological characterization of Kesterson Reservoir: Annual report, October 1, 1986 through September 30, 1987.** (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 193p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88008424/JAW.

Over the past two years scientists and engineers at Lawrence Berkeley Laboratory (LBL) and the Sanitary Engineering and Environmental Health Research Laboratory (SEEHRL) have investigated the effects of selenium contamination at Kesterson Reservoir. Selenium was present in food chain items at levels potentially toxic to birds by 1983. Although selenium concentrations have decreased in food chain items since drainage water inflow to the Reservoir ceased in 1986, selenium concentrations remain unacceptably high. Degradation of local groundwater resources, both from selenium contamination and accumulation of salts in near surface soils is also of concern. This report summarizes the results of a multidisciplinary program of research and monitoring activities aimed at providing a technical basis for choosing the best method for remediation of Kesterson Reservoir. 79 refs., 65 figs., 24 tabs.

37816 **(NIVA-E—87700/I) Sources, occurrence and effects of polycyclic aromatic hydrocarbons (PAH) in the aquatic environment - a preliminary review.** Knutzen, J. (Norsk Inst. for Vannforskning, Oslo). Apr 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752845/JAW.

Based on previous and more comprehensive reviews, applied with selected results from later work, the report intends to sum up in a concise way that part of today's knowledge about PAH which is assumed to be of most interest in relation to water resources management. 1 table, 35 references.

37817 **(NIVA-E—87700/II) Some observations of effects from polycyclic aromatic hydrocarbons (PAH) and fluoride in Norwegian marine recipients of aluminium smelter waste.** Knutzen, J. (Norsk Inst. for Vannforskning, Oslo). May 1987. 29p. NTIS (US Sales Only), PC A03. Order Number DE88752846/JAW.

Observations in Norwegian marine recipients of aluminium smelter waste have only shown marked ecological effects in the near zone (< 1 km) of scrubber effluents or in the vicinity of deposits rich in PAH and fluoride. However, 1-3 orders of magnitude excess concentrations of PAH in mussels, snails and seaweeds have been observed at distances more than 20 km from the sources, thus imposing restrictions on aquaculture in a considerable fjord area. Fluoride concentrations about 5 times the /sup n/ormal/sup /level have been observed in seaweeds exposed to less than the double natural fluoride content of water. No significant contamination was recorded in limpets. 10 drawings, 4 tables, 31 references.

37818 **(ORNL/TM—10682) Laboratory studies of methods for the treatment and disposal of the waste stream from the silver-recovery facility at Oak Ridge National Laboratory.** Parrott, J.R. Jr.; Strandberg, G.W. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011703/JAW.

Studies have shown that the waste stream, resulting from the process used to recover silver from spent photographic solutions at the Department of Energy's Oak Ridge National Laboratory (ORNL) and Y-12 Plant facilities can be disposed of via ORNL's sewage treatment plant. The results of laboratory studies of alternative treatment methods are discussed. 3 refs., 3 tabs.

37819 **(PB—88-180310/XAB) Importance of hydrogen ions and aluminium in regulating the structure and function of stream ecosystems: an experimental test.** Hall, R.J.; Driscoll, C.T.; Likens, G.E. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). 1987. 29p. (EPA—600/J-87/264). NTIS, PC A03/MF A01.

Pub. in Freshwater Biology 18, 17-43(Aug 1987).

Experiments simulating spring acidic snowmelt episodes were conducted to determine the effects of short-term inputs of H^+ and Al on the chemistry and biology of a poorly buffered mountain

stream. HCl and $AlCl_3$ were added in separate experiments to first- to third-order reaches of a New Hampshire stream. Some aspects of the study addressed cation exchange, foam production at the water surface, total phosphorus measurements, drift of mayfly nymphs, blackfly and chironomid larvae and stream pH.

37820 **(PB—88-181813/XAB) Fate and effects of dispersed and non-dispersed oil in Arctic mud flats.** Sveum, P. (SINTEF, Trondheim (Norway)). 29 Dec 1987. 24p. (STF—21-A87119). NTIS, PC E03/MF E03.

Dispersants have been mostly applied after oil-pollution incidents on the sea. In some cases, however, the use of dispersants on the sea shore has been used to such an extent and with such harmful effects that a long-lasting bad reputation has been established. The main idea of the present experiments have been to evaluate how three different dispersants affects the biodegradation of oil, the physical removal of oil, and the sediment-living microfauna and flora of oil-contaminated mudflats on Spitsbergen.

37821 **(PB—88-183058/XAB) Aquatic cycling of selenium: implications for fish and wildlife.** Lemly, A.D.; Smith, G.J. (National Fisheries Contaminant Research Center, Columbia, MO (USA)). 1988. 15p. (FISH/WILDLIFE LEAFL—12). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 87-600456.

Selenium, a non-metallic trace element, is readily accumulated by aquatic organisms. The degree of mobility or cycling rate of selenium in an aquatic ecosystem will largely determine whether toxicity occurs and how long the environmental hazard remains. The selenium cycle is made up of immobilization and mobilization processes that move the element between organisms, water, and sediment, with kinetics determined by chemical and physical factors related to the type of habitat present and its spatial variability. Because of its ability to bioaccumulate and cause adverse reproductive effects at low environmental concentrations, selenium should be recognized as a contaminant with the potential to severely impact fish and wildlife populations.

37822 **(PB—88-184882/XAB) Improved laboratory dispersant-effectiveness test. Final report.** Shum, J.S. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). Mar 1988. 117p. NTIS, PC A06/MF A01.

The U.S. Environmental Protection Agency (EPA) initiated a program to evaluate an Improved Laboratory Dispersant Effectiveness Test (ILDET) developed to replace EPA's Revised Standard Dispersant Effectiveness Test (RSDET). The report summarizes the development of the ILDET. The improved test provides a method to evaluate dispersant effectiveness in a physically realistic condition. The test energy level is dynamically similar to the small-scale ocean turbulence responsible for droplet formation. A preliminary evaluation of the test was conducted to assess the various factors that may affect the precision of the test. The preliminary evaluation shows a possible improvement in precision over the existing EPA method.

37823 **(PB—88-185244/XAB) Controlling arsenic, fluoride, and uranium by point-of-use treatment.** Fox, K.R.; Sorg, T.J. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). 1987. 6p. (EPA—600/J-87/283). NTIS, PC A02/MF A01.

Pub. in Jnl. of American Water Works Association, Vol. 79, No. 10, 81-84(Oct 1987).

Arsenic and other inorganic contaminants are found in the water supplies of many small communities. One possible solution for the problem of inorganic contaminants is point-of-use treatment, which can be used by individual homes or small communities. Ion exchange, activated alumina, and reverse osmosis point-of-use treatment units have been evaluated by the U.S. Environmental Protection Agency, and each system was found to be effective under certain operating conditions. Data from various field projects are presented, along with laboratory data on the removal of specific contaminants.

37824 **(PB—88-186309/XAB) Summary of Maryland stream pH and alkalinity data: analysis of its application to assessing the impacts of acidic deposition. Final report.** Janicki, A.; Greening, H. (Versar, Inc., Columbia, MD (USA)). Sep 1987. 68p. NTIS, PC A04/MF A01.

See also PB—88-186317.

Stream-chemistry data were gathered from a number of sources to characterize the sensitivity of flowing waters in Maryland to acidification, as well as to provide baseline information for the design of a synoptic survey of stream chemistry conducted in 1987. Overall, 19% of Maryland streams, for which data were collected, exhibit mean alkalinity values of less than 200 micro eq/L, generally considered to be indicative of waters sensitive to acidification. Minimum alkalinity values less than 200 micro eq/l were found in 41% of the data sets examined. Mean pH values less than 6.0 were observed in about 9% of the streams for which data were identified. Minimum pH values less than 6.0 were observed in 24% of the streams.

37825 **(PB—88-195656/XAB) Environmental bibliography for northwest Florida 1900-1985.** McErlean, A.J.; Means, S.M. (Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab.). Apr 1988. 325p. (EPA—600/8-88/068). NTIS, PC A14/MF A01.

This bibliography attempts to identify, acquire, and index available literature resources that can be used for decision making and environmental research. It also includes a technical data base for studies related to the area from Cape San Blas, Florida to Baldwin County, Alabama.

37826 **(PB—88-863907/XAB) Toxicity bioassays: water-pollution effects on aquatic animals and plants. June 1986-May 1988 (Citations from the Selected Water Resources Abstracts data base). Report for June 1986-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 37p. NTIS PC N01/MF N01.

Supersedes PB—87-861100.

This bibliography contains citations concerning toxicity bioassay studies of water pollution effects on reproduction, growth, and mortality of aquatic animals and plants. Industrial and agricultural water pollutants such as metals, chemicals, pesticides, and herbicides are evaluated and tested. Standard fishes and algal assays are used to determine effects of potential toxicants. (This updated bibliography contains 62 citations, 12 of which are new entries to the previous edition.)

37827 **(PNL—6536) Ground-water monitoring compliance projects for Hanford Site facilities: Progress report, October 1-December 31, 1987.** (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 92p. NTIS, PC A05;3. Order Number DE88010687/JAW.

This report documents the progress of four Hanford Site ground-water monitoring projects for the period from October 1 to December 31, 1987. The four disposal facilities are the 300 Area Process Trenches, 183-H Solar Evaporation Basins, 200 Areas Low-Level Burial Grounds, and Nonradioactive Dangerous Waste (NRDW) Landfill. The four ground-water monitoring projects discussed in this report have been designed according to the applicable ground-water monitoring requirements specified in the Resource Conservation and Recovery Act, and in Washington Administrative Code 173-303. During this reporting period, field activities consisted of completing repairs on two monitoring wells around the 183-H Basins and completing construction of the last 10 of 35 monitoring wells around the 200 Areas Burial Grounds. These wells were completed by November 30, 1987, in compliance with the above-referenced Compliance Order. Pretest hazardous chemical analyses of ground-water samples and aquifer tests were conducted in the 200 Area wells, where possible. The data are presented in this report. Analytical results for the 300 Area, 183-H, and the NRDW Landfill indicate no deviations from the established trends reported in previous progress reports. 13 refs., 15 figs., 12 tabs.

37828 (RISO-M—2630, pp 38-40) **Effect of ozone, nitrogen oxides and metal cations on polycyclic aromatic hydrocarbons.** Tuominen, J. (Technical Research Centre of Finland, Food Research Laboratory, Biologink. 1, Espoo (FI)). Jan 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752926/JAW. (CONF-8709266—).

From 6. workshop of the working party 2 "chemical and photochemical reactions" of the concerted action "physico-chemical behaviour of atmospheric pollutants"; Roskilde, Denmark (17 Sep 1987).

37829 **Kinetics of chromium(II) oxidation to chromium(VI) by reaction with manganese dioxide.** Eary, L.E.; Rai, D. (Battelle, Pacific Northwest Labs., Richland, WA (USA)). *Environmental Science and Technology;* **21**: No. 12, 1187-1193(Dec 1987).

The kinetics of oxidation of aqueous Cr(III) to Cr(VI) by reaction with pyrolusite [β-MnO_2(s)] were studied in aerated and deaerated solutions at 27°C for pH 3.0-10.1, for 10/sup -4.7/-10/sup -3.4/ M Cr(III), and as a function of β-MnO_2(s) surface area to assess the possible effects on Cr transport in industrial waste materials. The oxidation of aqueous Cr(III) is not appreciably affected by dissolved oxygen, indicating that Cr(III) reacts directly with β-MnO_2(s) to produce Cr(VI) and not by catalyzed reactions with oxygen at the β-MnO_2(s) surface. In acidic solutions, the oxidation of aqueous Cr(III) is highly nonlinear with time, possibly because strong adsorption of the produced anionic Cr(VI) species limits the amount of Cr(III) species able to contact active oxidizing sites on the β-MnO_2(s) surface. The following expression is derived from the rate data for pH 3.0-4.7 that empirically account for the nonlinear rate by describing the reaction rate in terms of the fraction of Cr(VI) to total Cr, f/sub Cr/, remaining in solution: df/sub Cr/dt (s^{-1}) = k(AV)[Cr/sub t/]$^{-1}$(1.0 - f/sub Cr/)/sup 3.2 (+/- 0.8) for f/sub Cr/ $\leq$ 1.0 where k = 2.0 (+- 1.6) x 10^{-2} mol x m^{-2} x s^{-1}, AV is the β-MnO_2(s) surface area to solution volume ratio in m^2 x L^{-1}, and [Cr/sub t/] is the molar concentration of total dissolved Cr. In slightly acidic to basic solutions, the oxidation of aqueous Cr(III) is very slow and is limited by the low solubility of $Cr(OH)_3$(s). 19 references, 6 figures, 4 tables.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 35725, 35734, 35762, 35799, 35817, 35846, 35876, 36347, 36385, 37719, 37720, 37721, 37722, 37723, 37724, 37768, 37772, 37852, 37930, 38016

37830 (DOE/AL/10752—39) **Chemical and radiochemical characteristics of groundwater in the Culebra Dolomite, southeastern New Mexico.** Chapmen, J.B. (New Mexico Health and Environment Dept., Santa Fe (USA). Environmental Evaluation Group). Mar 1988. Contract AC04-78AL10752. 65p. (EEG—39). NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88008123/JAW.

The nation's first geologic repository for radioactive waste is being excavated in southeastern New Mexico at the Waste Isolation Pilot Plant (WIPP). Post-closure radioactive release scenarios from WIPP often involve hydrologic transport of radionuclides through the overlying Rustler Formation, in the Culebra Dolomite Member. The Environmental Evaluation Group (EEG) has conducted an investigation of the chemistry of culebra groundwater. Analysis revealed the following: salinities in Culebra groundwater generally increase from west to east; a Na-Cl type water dominates over most of the sampled area with a Ca-SO_4 type occurring in the southern to southwestern area; exclusive of the low-salinity southern area, most wells located on the same general flow path have similar ion ratios; dissolved uranium content in Culebra groundwater is relatively high, with marked disequilibrium between U-238 and U-234 activities; Ra-226 and Ra-228 are sometimes present in relatively large amounts; Th-228 was detected in samples from 5 wells; and Cs-137 was detected in several samples. 39 refs., 21 figs., 2 tabs.

37831 (DOE-RW—88,031) **Modelling the interactions between radionuclides and particles in the ocean for assessments of sea disposal of radioactive waste.** Delow, C.E.; Mobbs, S.F. (National Radiological Protection Board, Chilton (UK)). (Department of the Environment, London (UK)). Jan 1988. 80p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753987/JAW.

This report describes work connected with the combined ocean dispersion and sedimentation model developed by MAFF/NRPB. Firstly, the ability of the model to reproduce the observed profiles of nine naturally occurring tracers was studied. Secondly, a number of sensitivity analyses on the sedimentation component of the model were performed. Thirdly, the effect of variations in bioturbation rate and of the inclusions of turbiditic sedimentation or coastal scavenging were studied. The results are used to draw conclusions on the adequacy of the model.

37832 (DOE-RW—88,036) **UK Natural Analogue Co-Ordinating Group: first annual report.** Hooker, P.J.; Chapman, N.A. (eds.). (British Geological Survey, Keyworth. Fluid Processes Research Group). (Department of the Environment, London (UK)). Nov 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753988/JAW.

The British Geological Survey is reponsible for co-ordinating the Department of the Environment's programme of natural analogue studies of radionuclide migration, a research programme that involved both UK and overseas sites. Co-ordination is achieved through the UK Natural Analogue Co-ordinating Group (NACG) which was established in October 1986. It has met three times to date and its function is to ensure that the different research projects have an integrated purpose aimed at improving and applying our understanding of natural geochemical processes in a way that will increase our confidence in long-term modelling predictions. Improved modelling prediction of radionuclide transport in the geosphere will directly benefit the performance and safety assessments of proposed radioactive waste repositories.

37833 (DP—1739-1) **Comprehensive cooling water study: Volume 1, Summary of environmental effects, Savannah River Plant: Final report.** Halverson, N.V. (ed.); Gladden, J.B.; Lower, M.W.; Mackey, H.E. Jr.; Specht, W.L.; Wilde, E.W. (Savannah River Lab., Aiken, SC (USA)). Oct 1987. Contract AC09-76SR00001. 91p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010377/JAW.

The Comprehensive Cooling Water Study (CCWS) was initiated in 1983 to evaluate the environmental effects of the intake and release of cooling water on the structure and function of aquatic ecosystems at the Savannah River Plant. The initial report (Gladden et al., 1985) described the results from the first year of the study. This document is the final report and concludes the program. The report comprises eight volumes. Volume I is a summary of environmental effects. 60 refs., 13 figs.

37834 (DP—1739-3) **Comprehensive Cooling Water Study: Volume 3, Radionuclide and heavy metal transport, Savannah River Plant: Final report.** Lower, M.W. (ed.). (Savannah River Lab., Aiken, SC (USA)). Oct 1987. Contract AC09-76SR00001. 362p. NTIS, PC A12/MF A01;1; GPO Dep. Order Number DE88010405/JAW.

The Comprehensive Cooling Water Study (CCWS) was initiated in 1983 to evaluate the environmental effects of the intake and release of cooling water on the structure and function of aquatic ecosystems at the Savannah River Plant (SRP). The initial report described the results from the first year of the study. This document is the final report and concludes the program. The report comprises eight volumes. Volume III, the Radionuclide and Heavy Metal Transport Program of the Comprehensive Cooling Water Study, was designed to assess the distribution and transport of radionuclides and heavy metals in onsite stream and Savannah River floodplains. The conclusion that SRP cooling water discharges are not having significant offsite radiological impacts is verified by: (1) routine radiochemical data collected from Savannah River water and sediment analysis programs; (2) radionuclide data collected from raw and finished water and holding pond sediment analyses

from downriver treatment plant facilities; and (3) calculated dose to man estimates of the maximum population and individual radioactive uptake resulting from consumption of finished water from the downriver treatment facilities. 58 refs., 56 figs., 134 tabs.

37835 **(INIS-BR—1025) Introduction and optimization of methods for isotopic determination of thorium and uranium via α-spectroscopy and their applications in analysis of water from Morro do Ferro, Brazil.** Vale, M.G.R. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1982. 119p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702290/JAW.

Methods for isotopic determination of thorium and uranium via α-spectroscopy, using a surface barrier detector, are described. The methods were applied in surface waters, borehole water, sediments and minerals from Morro do Ferro (MG), Brazil. Results and analysis by different techniques are compared and some discussions concerning to Th-concentration levels and anomalous isotopic and nuclidic ratios are presented.

37836 **(INIS-BR—1034) Thorium - humic compound interaction in the water of Morro do Ferro (Pocos de Caldas, MG, Brazil).** Kuechler, I.L. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1986. 170p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702298/JAW.

Experimental procedures and results are presented on the determination of thorium and organic dissolved carbon (DOC) in natural waters (bore hole and surface waters) from the Morro de Ferro, a thorium - rare earth occurrence situated in the Pocos de Caldas Plateau in Minas Gerais (Brazil). A positive correlation between Th-232 and humic compounds content was observed. Utilizing ultrafiltration techniques with Amicon membranes (XM-300, PM-10, UM-10 and YM-2), organic compounds with molecular weights above 1000 units were separated and concentrated from waters. Percolation waters rich in organic material concentrate DOC and Th-232 in the high molecular weight fractions (> 10.000 MW units). Humic acid was separated from a percolation water sample and characterized by elemental and infrared spectroscopic analysis. The distribution coefficient of Th-232 between water and sediment was shown to be inversely correlated to DOC concentration, as reported by other authors for different environments. These results were also confirmed by laboratory experiments, which indicated additionally that low concentrations of humic acid (< 5 mg/l) are insufficient for maintaining thorium in solution. All analysed waters showed humic compounds in the ultrafiltrates; However, in ground waters the content of humic and fulvic acids is generally too low to influence significantly thorium solubility.

37837 **(NSS/R—111) Evolution of the groundwater chemistry around a nuclear waste repository.** Haworth, A.; Sharland, S.M.; Tasker, P.W.; Tweed, C.J. (United Kingdom Nirex, Ltd.). Dec 1987. 13p. (CONF-8711100—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753613/JAW.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (30 Nov 1987).

Some of the necessary techniques to construct a research model of the evolution of the groundwater under the influence of the backfill material in a nuclear waste repository are developed. These involve various extensions to the coupled ionic migration and chemical equilibria code, CHEQMATE. These extensions have been used in the first stages of a model of the chemical environment within the host rock. In this preliminary model we have considered a concrete backfill material embedded in a clay geology. However, the model is sufficiently flexible that other backfill materials and host rocks may be considered if a good thermodynamical description is available. The preliminary results from the model suggest that over timescales of about a thousand years the natural buffering action of the clay against changes in pH has a significant effect on the scale of perturbation by the ingress of highly alkaline porewater. It seems likely therefore that this type of modelling will have considerable relevance to the safety assessment models.

37838 **(SKI—85062) Implementation and integration of program packages NAMMU and HYPAC.** Nedbal, T. (Swedish Nuclear Power Inspectorate, Stockholm). May 1986. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752500/JAW.

This work is prepared for the Swedish Power Inspectorate (SKI). The SKI has from the Atomic Energy Research Establishment (AERE) at Harwell, U.K., acquired the computer model NAMMU for groundwater hydrology calculations. The code was first implemented on an AMDAHL 470, a IBM compatible computer, and then modified in order to integrate it with HYPAC, which is a program package for pre- and post-processing finite element data, developed by KEMAKTA AB. This report describes the modifications done to both NAMMU and HYPAC, and the verification of the coupled program system NAMMU-HYPAC.

37839 **Human exposure to volatile organic compounds in household tap water: the indoor inhalation pathway.** McKone, T.E. (Lawrence Livermore National Lab., CA (USA)). *Environmental Science and Technology;* **21**: No. 12, 1194-1200(Dec 1987). Contract W-7405-ENG-48.

This paper addresses the quantification of human exposure to volatile organic compounds (VOC's) as a result of mass transfer from tap water to indoor air. A three-compartment model is developed and used to simulate the 24-h concentration profile within the shower, bathroom, and remaining household volumes of a dwelling. Mass transfers from water to air are derived from measured data for radon and adjusted to account for the difference in mass-transfer properties for VOC's. A preliminary data base for household parameters is used to calculate a range of concentrations and human exposures in U.S. dwellings. The model is used to estimate exposure factors for seven compounds-chloroform, ethylene dibromide, dibromo-chloropropane, methylchloroform, perchloroethylene, trichloroethylene, and carbon tetrachloride. The calculated ratio of indoor-air exposure to tap water concentration is compared to measured values for one of the compounds, chloroform. A sensitivity analysis is used to identify important parameters. 21 references, 3 figures, 8 tables.

5204 Thermal Effluents Monitoring And Transport

37840 **(DP—1739-2-Vol.2) Comprehensive cooling water study: Volume 2, Water quality, Savannah River Plant: Final report.** Lower, M.W. (ed.). (Savannah River Lab., Aiken, SC (USA)). Oct 1987. Contract AC09-76SR00001. 236p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88010409/JAW.

The Comprehensive Cooling Water Study (CCWS) was initiated in 1983 to evaluate the environmental effects of the intake and release of cooling water on the structure and function of aquatic ecosystems at the Savannah River Plant. The initial report described the results from the first year of the study. This document is the final report and concludes the program. The report comprises eight volumes. The first is a summary of environmental effects. The other seven volumes address water quality, radionuclide and heavy metal transport, wetlands, aquatic ecology, Federally endangered species, ecology of Par Pond, and waterfowl. 60 figs., 70 tabs.

37841 **(DP—1739-4) Comprehensive cooling water study: Volume 4, Wetlands: Final report.** Mackey, H.E. (ed.). (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Sep 1987. Contract AC09-76SR00001. 170p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88010403/JAW.

The Comprehensive Cooling Water Study (CCWS) was initiated in 1983 to evaluate the environmental effects of the intake and release of cooling water on the structure and function of aquatic ecosystems at the Savannah River Plant. The initial report (Gladden et al., 1985) described the results from the first year of the study. This document is the final report and concludes the program. The report comprises eight volumes. The first is a summary of environmental effects. The other seven volumes address water quality, radionuclide and heavy metal transport, wetlands, aquatic ecology, Federally endangered species, ecology of Par Pond, and waterfowl. 87 refs. 49 figs., 58 tabs.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 37728, 37729, 37784, 37785, 37815, 37827, 37840, 37852, 38005

37842 (BNL—41147) The Washington, D.C. experiment. Patrinos, A.A.N.; Leach, M.J.; Binkowski, F.S. (Brookhaven National Lab., Upton, NY (USA); Environmental Protection Agency, Research Triangle Park, NC (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-880595—1). NTIS, PC A02;3. Order Number DE88009159/JAW.

From NAPAP atmospheric transport and modeling research program review meeting; Richmond, VA, USA (1 May 1988).

A representative sample of wintertime storms was sampled during the Washington Experiment. Although a clear upwind-downwind delineation was not possible for all storms, the sequential data in one case detected the veering of the urban plume. The analysis of the data is continuing and several diagnostic modeling calculations are pending. Consequently, this discussion is preliminary. Some of the conclusions are: (1) In general, the Washington Experiment replicates the results of the Philadelphia field studies. Urban emissions have a significant impact on the wet deposition of nitrate on the mesoscale with increases approaching 100% above regional background. The impact on sulfate deposition is not as large. Estimates of excess deposition amounts as fractions of total emissions are pending. (2) Similarities in the Philadelphia and Washington results implicate the transportation emissions in the deposition of excess nitrate. This is based on the absence of significant industrial activity in the Washington area. (3) Mesoscale circulations, induced by the complex topography in the area, can promote sharp variations in the air masses across the Washington-Baltimore corridor. These variations may include vertical gradients in oxidant concentrations and seriously affect ground-level acid deposition. 7 refs., 6 figs.

37843 (DP—1739-5) Comprehensive Cooling Water Study: Volume 5, Aquatic ecology, Savannah River Plant: Final report. Specht, W.L. (ed.). (Savannah River Lab., Aiken, SC (USA)). Oct 1987. Contract AC09-76SR00001. 567p. NTIS, PC A99/MF A01;1; GPO Dep. Order Number DE88010404/JAW.

The Comprehensive Cooling Water Study (CCWS) was initiated in 1983 to evaluate the environmental effects of the intake and release of cooling water on the structure and function of aquatic ecosystems at the Savannah River Plant. The initial report (Gladden et al., 1985) described the results from the first year of the study. This document is the final report and concludes the program. The report comprises eight volumes. The first is a summary of environmental effects. The other seven volumes address water quality, radionuclide and heavy metal transport, wetlands, aquatic ecology, Federally endangered species, ecology of Par Pond, and waterfowl. This report documents the results of the Aquatic Ecology Program of the Comprehensive Cooling Water Study. The purpose of the Aquatic Ecology Program was to determine the environmental impacts of cooling water intake and release on the biological communities of SRP streams and swamps and the Savannah River, and the significance of these impacts on the SRP environment. 171 refs., 132 figs., 165 tabs.

37844 (DP-MS—88-43) N:P ratios and physiological indicators of nutrient limitation in a southeastern reservoir. Tilly, L.J.; Chimney, M.J.; Newman, M.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC09-76SR00001. 13p. (CONF-8806135—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011550/JAW.

From Annual meeting of the American Society of Limnology and Oceanography; Boulder, CO, USA (12 Jun 1988).

Cooling water flow dominates the nutrient and phytoplankton dynamics of L-Lake, a reservoir receiving effluent from a nuclear reactor. Available N:P ratios shift relative to those of the source water (Savannah River) during the cooling process. Examination of N:P ratios suggested that N is limiting during times of cold flow, but P is limiting during thermal conditions. Laboratory biostimulation assays using Selenastrum capricornutatum and hot reactor effluent indicated that both N and P additions enhanced algal productivity. Changes in nutrient concentrations in epilimnetic waters, as the water mass moved downlake, suggested that N limitation was experienced by the phytoplankton. In situ microcosm enrichment studies clearly indicated that inorganic N limited algal growth. Both NH_3 and NO_3 additions were readily assimilated in a manner conforming to Michaelis-Menton kinetics. Algal growth and ortho-phosphate assimilation was slow in microcosms receiving ortho-phosphate additions only.

37845 (PB—88-863394/XAB) Lake restoration. January 1977-May 1988 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-May 1988. (National Technical Information Service, Springfield, VA (USA)). May 1988. 149p. NTIS PC N01/MF N01.

Supersedes PB—87-860938.

This bibliography contains citations concerning the economic aspects and environmental effects of lake restoration/rehabilitation. Topics include aeration/circulation, dilution/flushing, sediment removal/dredging, and neutralizing materials to reduce acidification of lakes. Eutrophication conditions and solutions are also discussed. (This updated bibliography contains 249 citations, 23 of which are new entries to the previous edition.)

37846 (SREL—24) Wood Storks of the Savannah River Plant: Foraging and breeding ecology: Comprehensive cooling water study final report. Coulter, M.C. (Savannah River Ecology Lab., Aiken, SC (USA)). Jun 1986. Contract AC09-76SR00819. 135p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88010877/JAW.

This report presents the results of studies from 1983 through 1985 that deal with the use of the Savannah River Swamp System (SRSS) by Wood Storks. We examine the locations on the SRSS where storks have been observed foraging on the SRSS, and the time of year when birds were seen in the swamp. We compare measurements of habitat characteristics, water quality, vegetation and prey density at foraging sites on the SRSS with similar measurements at other foraging sites in east-central Georgia. Finally, we examine food demand of storks breeding at the Birdsville colony as an indication of the time of year when the birds would be most in need of food.

37847 (SREL—31) Wood Storks of the Birdsville Colony and swamps of the Savannah River Plant: 1986 annual report. Coulter, M.C. (Savannah River Lab., Aiken, SC (USA)). Apr 1987. Contract AC09-76SR00819. 263p. NTIS, PC A12/MF A01;1; GPO Dep. Order Number DE88010878/JAW.

The Savannah River Ecology Laboratory (SREL) Wood Stork program is a long-term program including various facets. It is primarily aimed at determining the importance of the SRSS to foraging storks and managing the Kathwood Foraging Ponds. In order to accomplish this we have examined the breeding biology of the birds at the colony to determine when the birds may have maximum food demand. We have also studied foraging ecology of the birds in order to gain insights that would allow us to develop a more effective management plan for the Kathwood ponds. More specifically, the objectives of the work carried out in 1986 were: (1) to determine the locations of foraging sites of Wood Storks from the Birdsville colony and examine year-to-year variation in sites used; (2) to characterize in more detail the habitat, vegetation, water quality and prey density/biomass at these sites; (3) to observe the breeding birds to determine the times when food demands at the colony are greatest; (4) to examine the movement of storks from the rookery to foraging sites and relate seasonal trends to the breeding biology; (5) to examine the importance of the SRSS to foraging Wood Storks; and (6) to examine the movements of individual birds to determine the generality of the observed patterns. At the Kathwood ponds we monitored water quality to ensure that water conditions were optimal for the stocked aquatic prey, determined when to make the ponds available to the storks, and monitored the numbers of storks and other wading birds at the ponds. In this report, I present the results of the studies carried out during 1986.

5206 Regulations

REFER ALSO TO CITATION(S) 36486, 36487, 37730, 37731, 37786, 37787

37848 **(PB—88-184007/XAB) Handbook: improving POTW (Publicly Owned Treatment Works) performance using the Composite Correction Program Approach.** (Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information). Oct 1984. 270p. (EPA—625/6-84/008). NTIS, PC A12/MF A01.

It is clear that only the most-effective design and operation of pollution-control facilities will be adequate to ensure continued protection of this Nation's natural resources. It is essential that the authors achieve the maximum performance possible of existing Publicly Owned Treatment Works (POTWs) to achieve maximum benefit from their expenditures. The purpose of the Handbook is to provide POTW owners/administrators and the engineering community with a new source of information to be used in improving the performance of POTWs through application of the Composite Correction Program (CCP) approach. It is the intent of the manual to supplement the existing body of knowledge in this area.

37849 **(PB—88-185095/XAB) WASP4, a hydrodynamic and water-quality model - model theory, user's manual, and programmer's guide.** Ambrose, R.B.; Wool, T.A.; Connolly, J.P.; Schanz, R.W. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). Jan 1988. 317p. (EPA—600/3-87/039). NTIS, PC A14/MF A01.

See also PB—87-110995.

The Water Quality Analysis Simulation Program Version 4 (WASP4) is a dynamic compartment-modeling system that can be used to analyze a variety of water-quality problems in a diverse set of water bodies. WASP4 simulates the transport and transformation of conventional and toxic pollutants in the water column and benthos of ponds, streams, lakes, reservoirs, rivers, estuaries, and coastal waters. The WASP4 modeling system covers four major subjects--hydrodynamics, conservative mass transport, eutrophication-dissolved oxygen kinetics, and toxic chemical-sediment dynamics. The WASP4 modeling system consists of two stand-alone computer programs, DYNHYD4 and WASP4, that can be run in conjunction or separately. The hydrodynamic program, DYNHYD4, simulates the movement of water and the water quality program, WASP4, simulates the movement and interaction of pollutants within the water. The latter program is supplied with two kinetic submodels to simulate two of the major classes of water-quality problems--conventional pollution (dissolved oxygen, biochemical oxygen demand, nutrients, and eutrophication) and toxic pollution (organic chemicals, heavy metals, and sediment). The substitution of either sub-model constitutes the models EUTRO4 and TOXI4, respectively.

37850 **(PB—88-186754/XAB) Environmental regulations and technology: use and disposal of municipal waste-water sludge.** (Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information). Sep 1984. 83p. (EPA—625/10-84/003). NTIS, PC A05/MF A01.

The document describes the five major sludge use/disposal options currently available--land application, distribution and marketing of sludge products, land-filling, incineration, and ocean disposal--and factors influencing their selection and implementation. It also provides an initial framework for evaluating sludge use/disposal alternatives, and describes accepted and proven use/disposal technologies and Federal regulations pertinent to sludge management.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 35842, 36485, 36496, 36506

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 36155, 36486, 37777, 37778, 37779

37851 **(DOE/EA—0265) Revised proposed general power marketing criteria and allocation criteria for Salt Lake City area: Environmental assessment.** (USDOE Western Area Power Administration, Boulder City, NV. Boulder City Area Office). Apr 1985. 208p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88010396/JAW.

Potential economic impacts on the human environment are stressed because the determination was made early in the assessment process that no interaction with components of the natural environment was expected. This determination was made on the basis that no change in operations of any facilities would result from implementation of the Allocation Criteria. The economic analyses involve investigation of Conservation and Renewable Energy Article, Resale of Electric Energy Article, the ten-year contract term, the method of power and energy allocation, the amounts of marketable firm power and energy, and the method of billing the cost of firming purchases on a pass-through basis.

37852 **(DOE/EIS—0120-Vol.1) Waste management activities for groundwater protection: Savannah River Plant, Aiken, South Carolina: Final environmental impact statement.** (USDOE, Washington, DC). Dec 1987. 450p. NTIS, PC A19;3. Order Number DE88008131/JAW.

The purpose of this environmental impact statement (EIS) is to assess the environmental impacts of proposed modifications and their alternatives to hazardous, low-level radioactive, and mixed waste management activities at the Savannah River Plant. The EIS, which is both a programmatic and a project-specific document, considers implementation of remedial and closure actions at hazardous, low-level radioactive, and mixed waste sites; establishment of new onsite disposal facilities for hazardous, low-level, and mixed wastes; potential changes in the discharge of disassembly-basin purge water from C-, K-, and P-Reactors to seepage basins. This EIS assesses the impacts of the modifications to waste management activities on air and water quality, especially on groundwater, ecological systems, health risk, archaeological resources, endangered species, and wetlands. Emphasis is given to the requirements of the Resource Conservation and Recovery Act, as amended, the Comprehensive Environmental Response, Compensation and Liability Act, as amended, and DOE Orders related to hazardous, low-level radioactive, and mixed wastes. 33 refs., 13 figs., 78 tabs.

37853 **(DOE/EIS—0120-Vol.2) Waste management activities for groundwater protection: Savannah River Plant, Aiken, South Carolina: Final environmental impact statement.** (USDOE, Washington, DC). Dec 1987. 556p. NTIS, PC A24/MF A01;1; GPO Dep. Order Number DE88008132/JAW.

Management of hazardous, low-level radioactive, and mixed waste for groundwater protection at the Savannah River Plant (SRP), Aiken, South Carolina is proposed. The preferred disposal alternative would involve modification of the SRP waste-management program to comply with all groundwater-protection requirements by implementing the following: (1) removal of wastes at selected existing waste sites to the extent practicable and implementing closure and groundwater remedial actions as required by applicable state and federal regulations; (2) establishment of a combination of retrievable storage, above ground, and below ground disposal facilities; and (3) continuation of the use of seepage and containment basins for the periodic discharge of reactor disassembly-basin purge. Groundwater contamination of aquifers would be controlled, improving on-site groundwater as well as surface water quality. As-

sociated public health risks, as well as risks associated with atmospheric releases, would be reduced. Risks from releases of transuranic and high level wastes, volatile organic compounds, heavy metals, radionuclides, and other miscellaneous chemicals would be contained. Some sites would be removed from public use. Other adverse impacts could include local and transitory on-site groundwater drawdown effects and minor short-term terrestrial impacts due to the use of borrow pits for backfill. Wildlife-habitat impacts could result due to land clearing and development. Volume 2 contains appendices A through F.

37854 **(DOE/EIS—0120-Vol.3) Waste management activities for groundwater protection: Savannah River Plant, Aiken, South Carolina: Final environmental impact statement.** (USDOE, Washington, DC). Dec 1987. 413p. NTIS, PC A18;3. Order Number DE88008133/JAW.

Management of hazardous, low-level radioactive, and mixed waste for groundwater protection at the Savannah River Plant (SRP), Aiken, South Carolina is proposed. The preferred disposal alternative would involve modification of the SRP waste-management program to comply with all groundwater-protection requirements by implementing the following actions: (1) removal of wastes at selected existing waste sites to the extent practicable and implementing closure and groundwater remedial actions as required by applicable state and federal regulations; (2) establishment of a combination of retrievable storage, above ground, and below ground disposal facilities; and (3) continuation of the use of seepage and containment basins for the periodic discharge of reactor disassembly-basin purge. Groundwater contamination of aquifers would be controlled, improving on-site groundwater as well as surface water quality. Associated public health risk, as well as risk associated with atmospheric releases, would be reduced. Risks from releases of transuranic and high level wastes, volatile organic compounds, heavy metals, radionuclides, and other miscellaneous chemical would be contained. Some sites would be removed from public use. Other adverse impacts could include local and transitory on-site groundwater drawdown effects and minor short-term terrestrial impacts due to the use of borrow pits for backfill. Wildlife-habitat impacts could result due to land clearing and development. Volume 3 contains Appendices G through L.

37855 **(DOE/EIS—0125-F) Intertie development and use: Final environmental impact statement: Volume 1, Environmental analyses.** (Bonneville Power Administration, Portland, OR (USA)). Apr 1988. 460p. NTIS, PC A20;3. Order Number DE88011480/JAW.

This environmental impact statement examines the environmental effects of three proposed Bonneville Power Administration actions with respect to the use and development of the Pacific Northwest/Pacific Southwest Intertie. The actions are: expansion of the capacity of the Intertie; adoption of a Long-Term Intertie Access Policy (IAP), which will set the ground rules for use of the Intertie by utilities other than BPA for short and long-term transmission of surplus power to California; and decisions by BPA to enable, through its access policies and marketing efforts, various types and levels of firm power marketing between the Northwest and California. BPA is proposing these actions in order to make possible additional short- and long-term sales of federal power surplus to that needed for serving Northwest loads and to increase the ability to deliver surplus power when the surplus is most valuable to the importing region. Additionally, the actions are needed to increase economic efficiency, to support environmental quality goals, and to enhance the ability of BPA to repay its US Treasury investment in a timely fashion while maintaining reasonable power rates for its wholesale customers in the Northwest. There is a need for an equitable procedure to allocate access to Intertie capacity that is excess to what BPA requires for its own use and to provide opportunities for assured access to make possible long-term firm power transactions by utilities other than BPA. 192 refs., 22 figs., 90 tabs.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 38514

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 37859, 38009, 38010

5502 Biochemistry

REFER ALSO TO CITATION(S) 35914, 35966, 35968, 35971, 35973, 35980, 35981, 36001, 36487, 37865, 37925, 38004

37856 **(DOE/ER/13359—T1) Mechanisms and control of K^+ transport in plants and fungi: Research progress report.** (Yale Univ., New Haven, CT (USA)). [1988]. Contract FG02-85ER13359. 2p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011238/JAW.

This report briefly describes experiments on transport responses to long-and short-term temperature changes in Neurospora, preliminary chracterization of potassium channels in the plasma membrane of Arabidopsis protoplasts, and cloning of the gene for high-affinity K^+ transport in Neurospora.

37857 (INIS-BR—1018, pp 13) **X-ray diffracion: crystal and molecular structures of an analogous of anti - juvenile hormones.** Zukerman-Schpector, J.; Simone, C.A. de; Castellano, E.E. (Alagoas Univ., Maceio (Brazil). Lab. de Cristalografia; Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

37858 **(LA—11105-PR) Life Sciences Division: Annual report, 1986.** Fink, M. (comp.). (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 130p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88010472/JAW.

This report summarizes research and development of the Life Sciences Division of Los Alamos National Laboratory for the calendar year 1986. Activities of the Life Sciences Division were supported by the US Department of Defense, the National Institutes of Health, the Nuclear Regulatory Commission, and private industry. Technical reports offer the informed reader sufficient detail to assess the scope and significance of projects. Summaries useful to the casual reader appear in the overview. Further information is available from the investigators on the staff of the Life Sciences Division.

37859 **(LA—11235-PR) Life Sciences Division: Annual report, 1987.** Ortiz, R.; Spitzmiller, D.; Scott, N. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 108p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010478/JAW.

This report summarizes the research and development activities of Los Alamos National Laboratory's Life Sciences Division for the calendar year 1987. Technical reports related to the current status of projects are presented in sufficient detail to permit the informed reader to assess their scope and significance. Summaries useful to the casual reader desiring general information have been prepared by the Group Leaders and appear in each group overview. Investigators on the staff of the Life Sciences Division will be pleased to provide further information. The individual programs are grouped as genomic structure and regulation, neural processing and chemistry, molecular structure, flow cytometry, cell growth and differentiation, radiation biology, pulmonary biology, and carcinogenesis.

37860 Circular dichroism microscopy of compact forms of DNA and chromatin in vivo and in vitro: cholesteric liquid-crystalline phases of DNA and single dinoflagellate nuclei. Livolant, F.; Maestre, M.E. (CNRS, Ivry-sur-Seine (France)). *Biochemistry;* **27**: No. 8, 3056-3068(19 Apr 1988). Contract AC03-76SF00098.

Two highly condensed structures of DNA have been analyzed in the circular dichroism (CD) microscope: the cholesteric liquid-crystalline phase of DNA and the nucleus of a dinoflagellate (Prorocentrum micans). In both cases, the DNA shows a helical cholesteric organization, but the helical pitch equals about 2500 nm in the first case and 250 nm in the second one. Since the absorption band of DNA is located at 260 nm, the reflection and absorption bands are well separated in the cholesteric phase of DNA and are overlapping in the dinoflagellate nucleus. However, both structures give a very strong negative CD signal at 265 nm. The authors show that this very strong signal cannot correspond to a Borrmann effect, i.e., to a superposition of the absorption and reflection bands, but is a differential absorption of left versus right circularly polarized light. This anomalous differential absorption is probably due to a significant scattering of light, inside of the structure, which produces a resonance phenomenon in the absorption band of the chromophore. Intercalative dyes were inserted in the dinoflagellate chromatin. The CD signal recorded in their absorption bands mimics the signal observed in the absorption band of DNA. In both structures, the negative sign of the CD at 265 nm indicates that the twist occurring between DNA molecules is left-handed, and they show that this situation is the more frequently encountered in vivo and in vitro.

37861 Transposon tagging and molecular analysis of the maize regulatory locus opaque-2. Schmidt, R.J.; Burr, F.A.; Burr, B. (Brookhaven National Lab., Upton, NY (USA)). *Science (Washington, D.C.);* **238**: 960-963(13 Nov 1987).

Genetic analyses suggested that the opaque-2 (o2) locus in maize acts as a positive, transacting, transcriptional activator of the zein seed storage-protein genes. Because isolation of the gene is requisite to understanding the molecular details of this regulation, transposon mutagensis with the transposable element suppressor-mutator (Spm) was carried out, and three mutable o2 alleles were obtained. One of these alleles contained an 8.3-kilobase autonomous Spm, another a 6.8-kilobase nonautonomous Spm, and the third an unidentified transposon that is unrelated to Spm. A DNA sequence flanking the autonomous Spm insertion was verified to be o2-specific and provided a probe to clone a wild-type allele. Northern blots indicated that the gene is expressed in wild-type endosperm but not in leaf tissues or in endosperms homozygous for a mutant allele of the O2 gene. A transcript was detected in endosperms homozygous for mutations at opaque-7 and floury-2, an indication that O2 expression is independent of these two other putative regulators of zein synthesis.

37862 Isolation and characterization of a cDNA clone encoding wheat germ agglutinin. Raikhel, N.V.; Wilkins, T.A. (Michigan State Univ., East Lansing (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 19, 6745-6749(Oct 1987). Contract AC02-76ER01338.

Two sets of synthetic oligonucleotides coding for amino acids in the amino- and carboxyl-terminal portions of wheat germ agglutinin were synthesized and used as hybridization probes to screen cDNA libraries derived from developing embryos of tetraploid wheat. The nucleotide sequence for a cDNA clone recovered from the cDNA library was determined by dideoxynucleotide chain-termination sequencing in vector M13. The amino acid sequence deduced from the DNA sequence indicated that this cDNA clone (pNVR1) encodes isolectin 3 of wheat germ agglutinin. Comparison of the deduced amino acid sequence of clone pNVR1 with published sequences indicates isolectin 3 differs from isolectins 1 and 2 by 10 and 8 amino acid changes, respectively. In addition, the protein encoded by pNVR1 extends 15 amino acids beyond the carboxyl terminus of the published amino acid sequence for isolectins 1 and 2 and includes a potential site for N-linked glycosylation. Utilizing the insert of pNVR1 as a hybridization probe, the authors have demonstrated that the expression of genes for wheat germ agglutinin is modulated by exogenous abscisic acid. Striking homology is observed between wheat germ agglutinin and chitinase, both of which are proteins that bind chitin.

5503 Cytology

REFER ALSO TO CITATION(S) 35967, 37868, 37917

37863 (CONF-8803102—3) Ultrastructure and function of erythrocyte membrane skeleton. Shen, B.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012003/JAW.

From International conference on advanced science and technology; Chicago, IL, USA (19 Mar 1988).

The membrane of the human erythrocyte is reinforced along its entire cytoplasmic surface by a two-dimensional network of peripheral proteins that closely adhere to the membrane proper through specific protein-protein interactions. This protein network resembles a shell that retains the approximate size and shape of the membrane ghost and is generally termed the skeleton. Spectrin, the major constituent of the membrane skeleton, accounts for approximately 75% of the skeletal protein mass. The molecular structure of spectrin is discussed in this paper.

37864 (GSF—20/87) European symposium on cytometry. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). 1987. 70p. (CONF-8709282—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753542/JAW.

From European symposium on cytometry; Baden-Baden, F.R. Germany (25 Sep 1987).

This book of abstracts contains 59 contributions about cervical prescreening, expert systems, breast cancer, ploidy analysis, system and data evaluation, sampling, preparation and staining, image cytometry, general cytometry, cell kinetics with clinical applications.

5504 Genetics

REFER ALSO TO CITATION(S) 35568, 36488, 37858, 37859, 37924, 37925, 37926, 38139

37865 (DOE/ER/13588—2) Genetics and biochemistry of surfactant synthesis in arthrobacter species H13-A: Progress report, August 1, 1987-July 31, 1988. Finnerty, W.R. (Georgia Univ., Athens (USA). Dept. of Microbiology). 1988. Contract FG09-86ER13588. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011552/JAW.

We have sought the structural elucidation of the glycolipid biosurfactant. The extracellular glycolipid consists of 1 major component (>90%) plus 6–7 minor molecular species. The deacylated water-soluble backbone is common to all molecular species of the glycolipid. A complex fatty acid composition characterizes the glycolipid and contributes to its surface active character. The water soluble backbone consists of glycerol, trehalose and 3–5 glucose residues. FTIR spectroscopy has confirmed the presence of these polyhydric components. The next major objective has been to clone the genes for glycolipid biosynthesis in Rhodococcus sp. H13-A. Improvements in the E. coli-Rhodococcus shuttle vector, pMVS301, were made prior to the construction and screening of a genomic library in Rhodococcus. A system is being developed for transpositional mutagenesis in Rhodococcus, using Tn917 containing plasmids used successfully in Bacillus sp. for the isolation and analysis of sporulation and developmental genes. We are also actively assessing the utility of this cloning and transformation system which we have developed for Rhodococcus, for use in mycobacterium, a related Actinomycete for which there exists no systems for plasmid transformation or molecular cloning. 8 refs., 1 fig.

37866 (DOE/ER/60533—1) Studies of human mutation rates. Progress report. Neel, J.V. (Michigan Univ., Ann Arbor (USA). Dept. of Human Genetics). [1988]. Contract FG02-87ER60533. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011893/JAW.

Progress is reported on several areas of study relating to human mutation rates. Efforts to study mutation at the DNA level dealt mainly with the development of probes to be employed in the program. Also reported on were genetic follow-up studies at the Radiation Effects Research Foundation in Hiroshima and Nagasaki. In the area of theoretical and applied genetics, progress is reported in 5 areas: l)likelihood analysis and phylogenetic inference; b)comparative F-statistics analysis; c)parentage assessment; d)haplotypic analysis of human admixture; and e)allelic spectrum analysis in agglomerated populations.

37867 **(PB—88-190707/XAB) Conservation biology of Furbish's lousewort. Final report, 1983-1986.** Menges, E.S. (Butler Univ., Indianapolis, IN (USA). Holcomb Research Inst.). Feb 1988. 70p. (HRI—128). NTIS, PC A04/MF A01.

A four-year study of the federally endangered, endemic Furbish's lousewort (Pedicularis furbishiae), has documented its distribution, life history, population dynamics, environmental preferences, reproductive biology, and genetic constitution. Lousewort population biology is affected two ways by the disturbance regime of the St. John's River. First, ice scour and bank slumping have caused high overwinter mortality and local population extinction, especially on saturated or wet soil. Such disturbances are the primary threat to both individuals and populations. Second, continued lack of disturbance, which allows successional changes (high vegetation cover and dominance by woody species) also reduces survival, growth, recruitment, germination, and seedling survivorship. Conservation tactics should include protection of extant populations and maintenance of an extensive wooded riverine corridor, thus providing potential habitat within a natural hydrological disturbance regime.

37868 **Mechanisms involved in the formation of mutagen-induced chromosome aberrations as determined by premature chromosome condensation.** Wolff, S.; Pantelias, G.E. (Lab. of Radiobiology and Environmental Health, Univ. of California, San Francisco, CA 94143 (US)). pp 167-176 of Genetic toxicology of environmental chemicals. Part B: Genetic effects and applied mutagenesis. Ramel, C.; Lambert, B.; Magnusson, J. New York, NY; Alan R. Liss Inc. (1986). (CONF-8506137—).

From 4. international conference on environmental mutagens; Stockholm, Sweden (24 Jun 1985).

In conventional studies of cytogenetic damage induced by mutagenic carcinogens, chromosomes are examined only when they become visible at metaphase, which often is many hours after exposure. Because many events can occur between the initial exposure and the final appearance of the damaged chromosomes at metaphase, the authors have now turned to the use of prematurely condensed chromosomes (PCCs) in which it is possible to observe interphase chromosomes shortly after exposure without allowing the cells to proceed to metaphase. Such a procedure, which eliminates the long delays between the introduction of the initial damage and its visualization, gives initial insights to the possible mechanisms involved in the production of genetic damage by mutagenic carcinogens. They used the method to study the effect of the pyrimidine nucleoside analogue cytosine arabinoside (ara-C), an inhibitor of DNA synthesis and chemotherapeutic agent that kills S phase cells and blocks the progression of cells from G_1 into S phase. The authors now used a simple method for polyethylene-glycol-mediated cell fusion and PCC induction to analyze the effects of ara-C on G_0 human lymphocytes. The PCC technique is a far more sensitive method for detecting damage than are the conventional metaphase techniques. Moreover, because only limited information is available on the repair of radiation damage in lymphocytes in the presence of DNA synthesis inhibitors, the technique was also used study the effect of ara-C on the repair of X-ray-induced chromosome breakage in unstimulated lymphocytes.

5505 Metabolism

REFER ALSO TO CITATION(S) 35568, 35912, 35974, 37929, 37931

5506 Medicine

REFER ALSO TO CITATION(S) 37193, 37493, 37494, 37858, 37864, 37904, 37916, 37932, 37971, 38633, 38651

37869 **(BMU—1987-161) Efficacy of diagnostic radiation in paediatrics. 2nd report.** Fendel, H.; Schneider, K.; Bakowski, C.; Glas, J.; Drews, K.; Kohn, M.M. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). 1987. 222p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Our research team was given the task of studying the efficacy of diagnostic radiation in childhood. The goal of this study is to determine which diagnostic radiation has no efficacy and, because of its uselessness, should be avoided, and which procedure has only minimal efficacy so that in most cases it could be dispensed without negatively affecting the benefits for the patient or for public health. This second report comprises an extensive introduction and 9 chapters which were written partly by different authors and contain comprehensive references to deal with various aspects of diagnostic radiation in paediatrics. An appendix contains the questionnaires covering paranasal sinuses and head trauma, and also a motivating letter which was sent along with the questionnaires to doctors participating in the project.

37870 (GSI—87-11, pp H1.1-H1.3) **Hypoxia in human tumors: Experimental facts and therapeutic consequences.** Vaupel, P. (Mainz Univ. (Germany, F.R.). Inst. fuer Angewandte Physiologie). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37871 (GSI—87-11, pp I1.1-I1.3) **Present indications for neutron therapy.** Schmitt, G. (Duesseldorf Univ. (Germany, F.R.). Klinik fuer Strahlentherapie und Radiologische Onkologie). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37872 (GSI—87-11, pp I2.1-I2.5) **Pion therapy at SIN.** Greiner, R. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37873 (GSI—87-11, pp I3.1) **Results in pion dose escalation studies at TRIUMF.** Goodman, G.B. (Cancer Control Agency of British Columbia, Vancouver (Canada)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37874 (GSI—87-11, pp I4.1-I4.6) **Clinical proton beam therapy at Harvard.** Munzenrider, J.E. (Massachusetts General Hospital, Boston (USA). Dept. of Therapeutic Radiology; Harvard Medical School, Boston, MA (USA); Massachusetts General Hospital, Boston (USA). Radiation Medicine Service). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37875 (GSI—87-11, pp I5.1-I5.6) **Heavy ion radiotherapy.** Castro, J.R. (Lawrence Berkeley Lab., CA (USA); California Univ., San Francisco (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—). Contract AC03-76SF00098.

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37876 (GSI—87-11, pp I6.1-I6.3) **Heavy charged-particle Bragg peak stereotactic radiosurgery for intracranial arteriovenous malformations.** Fabrikant, J.I.; Frankel, K.A.; Phillips, M.H.; Levy, R.P.; Lyman, J.T.; Foster, M.L. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—). Contract AC03-76SF00098.

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37877 (GSI—87-11, pp K0.1-K0.4) **Need for improving physical selectivity with high-LET radiation: Rationale for heavy-ion programmes.** Wambersie, A. (Louvain Univ., Brussels (Belgium). Cliniques Universitaires St. Luc). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37878 (GSI—87-11, pp K1.1-K1.4) **Project of a 250 MeV biomedical proton beam line at SIN.** Blattmann, H.; Daum, M. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37879 (GSI—87-11, pp K2.1-K2.4) **Loma Linda University proton therapy facility.** Slater, J.M.; Miller, D.W. (Loma Linda Univ., CA (USA). Dept. of Radiation Oncology). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37880 (GSI—87-11, pp K3.1-K3.2) **Dynamic beam delivery systems for cancer therapy with heavy charged-particles.** Ludewigt, B.A.; Renner, T.R.; Chu, W.T. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—). Contract AC03-76SF00098.

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37881 (GSI—87-11, pp K4.1-K4.2) **EULIMA project.** Mandrillon, P. (Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France); Centre Antoine-Lacassagne, 06 - Nice (France)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37882 (GSI—87-11, pp K5.1-K5.4) **Future plans for heavy particle medical accelerator.** Tsunemoto, Hiroshi; Kawachi, Kiyomitsu. (National Inst. of Radiological Sciences, Anagawa (Japan)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37883 (GSI—87-11, pp K8.1-K8.4) **Medical proposal for SIS.** Gademann, G.; Sturm, V.; Hartmann, G.; Schlegel, W.; Flentje, M.; Kimmig, B.; Zum Winkel, K. (Heidelberg Univ. (Germany, F.R.). Universitaets-Strahlenklinik; Deutsches Krebsforschungszentrum, Heidelberg (Germany, F.R.). Inst. fuer Nuklearmedizin). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37884 (INIS-BR—1082) **Coils of radiofrequency for image producing by nuclear magnetic resonance. Resonators of medium capacity for 85 MHz.** Schmidt, M.A.; Tannus, A.; Bonagamba, T.J.; Leite, V.B.P.; Panepucci, H.C. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. 2p. (In Portuguese). (CONF-8709281—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702780/JAW.

From 10. Brazilian congress on biomedical engineering; Rio de Janeiro, Brazil (14 Sep 1987).

Published in summary form only.

37885 (INIS-BR—1083) **Sprayer for radioaerosol production of sup (99 m) Tc-DTPA.** Medeiros, R.B.; Alonso, G.; Nery, L.E. (Escola Paulista de Medicina, Sao Paulo (Brazil)). 1987. 1p. (In Portuguese). (CONF-8709281—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702781/JAW.

From 10. Brazilian congress on biomedical engineering; Rio de Janeiro, Brazil (14 Sep 1987).

Published in summary form only.

37886 (INIS-BR—1084) **Lung function studied by servo-controlled ventilator and respiratory mass spectrometer.** Piiper, J. (Max-Planck-Institut fuer Experimentelle Medizin, Goettingen (Germany, F.R.). Abt. Physiologie). 1987. 3p. (CONF-8709281—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702782/JAW.

From 10. Brazilian congress on biomedical engineering; Rio de Janeiro, Brazil (14 Sep 1987).

The gas exchange function of lungs is studied. The gas concentration, measured by mass spectrometry and the lung volume and rate of change of lung volume are discussed. A servo-controlled ventilator is presented. Several experimental projects performed on anesthetized paralyzed dogs are reported. (M.A.C.).

37887 (INIS-BR—1085) **Measurement of blood flow and arteriography by magnetic resonance.** Leite, V.B.P.; Bonagamba, T.J.; Tannus, A.; Schmidt, M.A.; Panepucci, H.C. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. 2p. (In Portuguese). (CONF-8709281—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702783/JAW.

From 10. Brazilian congress on biomedical engineering; Rio de Janeiro, Brazil (14 Sep 1987).

Published in summary form only.

37888 (INIS-BR—1086) **Development of devices and systems for quality control of mammographs.** Machado, L.M.R.C.; Frere, A.F. (Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia). 1987. 2p. (In Portuguese). (CONF-8709281—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702784/JAW.

From 10. Brazilian congress on biomedical engineering; Rio de Janeiro, Brazil (14 Sep 1987).

Published in summary form only.

37889 (INIS-BR—1087) **In vivo spectroscopy of ^{31}p by NMR: a medical diagnosis technique.** Bonagamba, T.J.; Tannus, A.; Leite, V.B.P.; Schmidt, M.A.; Panepucci, H.C.; Torre Neto, A.; Martins, M.J. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. 1p. (In Portuguese). (CONF-8709281—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702785/JAW.

From 10. Brazilian congress on biomedical engineering; Rio de Janeiro, Brazil (14 Sep 1987).
Published in summary form only.

37890 **(INIS-BR—1088) NMR images.** Tannus, A.; Bonagamba, T.J.; Martins, M.J.; Torre Neto, A.; Schmidt, M.A.; Leite, V.B.P.; Slaets, J.; Panepucci, H.C. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. 2p. (In Portuguese). (CONF-8709281—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702786/JAW.

From 10. Brazilian congress on biomedical engineering; Rio de Janeiro, Brazil (14 Sep 1987).
Published in summary form only.

37891 **(INIS-BR—1089) Computerized and adequated system of nuclear probe for left ventricular function studies.** Piva, R.M.V.; Robilotta, C.C.; Furuie, S.S. (Sao Paulo Univ. (Brazil). Faculdade de Medicina). 1987. 2p. (CONF-8709281—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702868/JAW.

From 10. Brazilian congress on biomedical engineering; Rio de Janeiro, Brazil (14 Sep 1987).
Published in summary form only.

37892 **(INIS-mf—11228) Computer processing of dynamic scintigraphic studies.** Ullmann, V. (Krajska Nemocnice s Poliklinikou, Ostrava (Czechoslovakia)). 1985. 184p. (In Czech). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702877/JAW.

The methods are discussed of the computer processing of dynamic scintigraphic studies which were developed, studied or implemented by the authors within research task no. 30-02-03 in nuclear medicine within the five year plan 1981 to 85. This was mainly the method of computer processing radionuclide angiography, phase radioventriculography, regional lung ventilation, dynamic sequential scintigraphy of kidneys and radionuclide uroflowmetry. The problems are discussed of the automatic definition of fields of interest, the methodology of absolute volumes of the heart chamber in radionuclide cardiology, the design and uses are described of the multipurpose dynamic phantom of heart activity for radionuclide angiocardiography and ventriculography developed within the said research task. All methods are documented with many figures showing typical clinical (normal and pathological) and phantom measurements. (V.U.).

37893 (INIS-mf—11233, pp 29) **Development of soluble synthetic polymers as a potential drug delivery system for the treatment of iron overload.** O'Hare, K.B.; Duncan, R.; Kopecekova, P.; Kopecek, J. (Keele Univ. (UK); Ceskoslovenska Akademie Ved, Prague. Ustav Makromolekularni Chemie). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37894 (INIS-mf—11233, pp 33) **Treatment of methylmercury poisoning by subchronic administration of sodium 2,3-dimercapto-1-sulfonate (DMPS).** Schaefer, S.G. (Muenchen Univ. (Germany, F.R.). Inst. fuer Pharmakologie und Toxikologie). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37895 (INIS-mf—11233, pp 13) **Objective evidence of the efficacy of chelation therapy by radionuclide studies in patients with heart and brain disorders.** Casdorph, H.R. (Long Beach State Coll., CA (USA)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37896 (INIS-mf—11233, pp 34) **Diagnostic use of technetium-99m chelates.** Spies, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37897 **(ISH—104) Radiation exposure of patients due to medical measures.** Schwarz, E.R.; Tsavachidis, C.; Hinz, G.; Eigelsreiter, H. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jan 1987. 223p. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

The main objective of this research project supported by the Federal Ministry of the Interior was to collect the data required as a basis for an up-to-date assessment of the radiation exposure of the population as a result of medical measures. Apart from the fact that this had to be done in order to fulfill a commitment required by the EURATOM principles, the report in hand also presents a useful survey of the improvements achieved over the last years in terms of radiation hygiene in the field of imaging technology applied for medical diagnostics. The data obtained from four hospital centers (2 university hospitals, 1 city hospital, and one county hospital) and from three medical practices (radiologist, internal specialist, orthopedics), the changes experienced in the selection of imaging methods for diagnostic purposes in the period 1976 to 1983 or 1985 are illustrated, and analyses show the developmental trends. The results show that there is reason to assume the radiation exposure of the population to be receding.

37898 (SSA—1987-TS-8, pp 201-202) **Post-transfusion survival of stored red cells double isotope labeling. I. protocol.** Fabre, G.; Saint-Blancard, J.; Messian, O.; Noel, L. (Centre de Transfusion Sanguine des Armees, 92 - Clamart (FR); Centre de Transfusion Sanguine et d'Hematologie, 78 - Versailles (FR)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

In order to study the in vivo post-transfusion survival of autologous RBC's, the authors utilize a double isotope labelling technique (stored cells with 51 Cr and fresh cells with 99 m Tc). The details of this technique are given in the present report.

37899 **Ultrasonic imaging with a fixed instrument configuration.** Witten, A.; Tuggle, J.; Waag, R.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6049). *Applied Physics Letters;* **53**: No. 1, 16-18(4 Jul 1988).

Diffraction tomography is a technique based on an inversion of the wave equation which has been proposed for high-resolution ultrasonic imaging. While this approach has been considered for diagnostic medical applications, it has, until recently, been limited by practical limitations on the speed of data acquisition associated with instrument motions. This letter presents the results of an experimental study directed towards demonstrating tomography utilizing a fixed instrument configuration.

37900 **X-ray diffraction study of the polymorphic behavior of N-methylated dioleoylphosphatidylethanolamine.** Gruner, S.M.; Tate, M.W.; Kirk, G.L.; So, P.T.C.; Turner, D.C.; Keane, D.T.; Tilcock, C.P.S.; Cullis, P.R. (Princeton Univ., NJ (USA)). *Biochemistry;* **27**: No. 8, 2853-2866(19 Apr 1988). Contract FG02-87ER60522.

The polymorphic phase behavior of aqueous dispersions of dioleoylphosphatidylethanolamine (DOPE) and its N-methylated analogues, DOPE-Me, DOPE-Me_2, and DOPC, has been investigated by X-ray diffraction. In the fully hydrated lamellar (L/sub α/) phase at 2°C, the major structural difference is a large increase in the interlamellar water width from DOPE to DOPE-Me, with minor increases with successive methylation. Consistent with earlier reports, inverted hexagonal (H/sub II/) phases are observed upon heating at 5-10 °C in DOPE and at 65-75 °C in DOPE-Me and are not observed to at least 85 °C in DOPE-Me_2 or DOPC. It is shown that, in copious water, the disordered state transforms very slowly

into phases with cubic symmetry. This process is assisted by the generation of small amounts of lipid degradation products. The relative magnitudes of the monolayer spontaneous radius of curvature, are inferred from the H/sub II/ lattice spacings vs temperature and are shown to increase with increasing methylation. The relative magnitudes of R_0 are categorized as small for DOPE, intermediate for DOPE-Me, and large for DOPC. The relationship between the cubic phases and minimal periodic surfaces is discussed. The geometry of the equilibrium phases that occur may be largely understood on the basis of a competition between a spontaneous tendency for the monolayers to curl to a radius, R_0, and the need to pack similar hydrocarbon chains at near constant density and at a uniform mean length.

5507 Microbiology

REFER ALSO TO CITATION(S) 35549, 35555, 35913, 37810

37901 **(DOE/SR/15151—2) The effect of tetraphenylborate and its known degradation products on selected species of soil microorganisms: Annual report, June 13, 1987-June 12, 1988.** Chapatwala, K. (Selma Univ., AL (USA). Div. of Natural and Applied Sciences). Mar 1987. Contract FG09-86SR15151. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010826/JAW.

We have identified the bacteria capable of utilizing NaTBP as the sole carbon source. Also we have determined the growth patterns of these bacteria. All the bacteria capable of utilizing NaTBP as the sole carbon source belong to the genus Pseudomonas. 3 refs.

5509 Pathology

REFER ALSO TO CITATION(S) 37684, 38006, 38007, 38008, 38011, 38124, 38125

5510 Physiological Systems

REFER ALSO TO CITATION(S) 38980

37902 **(AD-A—190579/3/XAB) Cortical dynamics of three-dimensional form, color, and brightness perception. 1. Monocular theory.** Grossberg, S. (Boston Univ., MA (USA). Center for Adaptive Systems). 1987. 31p. NTIS, PC A03/MF A01.

Pub. in Perception and Psychophysics, Vol. 41, No. 2, 87-116(1987). See also Part 2, AD-A190580.

A real-time visual-processing theory is developed to explain how three-dimensional form, color, and brightness percepts are coherently synthesized. The theory describes how several fundamental uncertainty principles that limit the computation of visual information at individual processing stages are resolved through parallel and hierarchical interactions among several processing stages. The theory provides unified analysis and many predictions of data about stereopsis, binocular rivalry, hyperacuity, McCollough effect, textural grouping, border distinctness, surface perception, monocular and binocular brightness percepts, filling-in, metacontrast, transparency, figural aftereffects, lateral inhibition within spatial frequency channels, proximity luminance covariance, tissue contrast, motion segmentation, and illusory figures, as well as about reciprocal interactions among the hypercolumns, blobs, and stripes of cortical areas V1, V2, and V4. Monocular and binocular interactions between a Boundary Contour (BC) System and a Feature Contour (FC) System are developed. The BC System, defined by a hierarchy of oriented interactions, synthesizes an emergent and coherent binocular boundary segmentation from combinations of unoriented and oriented scenic elements.

37903 **(AD-A—190580/1/XAB) Cortical dynamics of three-dimensional form, color, and brightness perception. 2. Binocular theory.** Grossberg, S. (Boston Univ., MA (USA). Center for Adaptive Systems). 1987. 31p. NTIS, PC A03/MF A01.

Pub. in Perception and Psychophysics, Vol. 41, No. 2, 87-116(1987). See also Part 1, AD-A190579.

A real-time visual-processing theory is developed to explain how three-dimensional form, color, and brightness precepts are coherently synthesized. The theory describes how several fundamental uncertainty principles that limit the computation of visual information at individual processing stages are resolved through parallel and hierarchical interactions among several processing stages. The theory provides a unified analysis and many predictions of data about stereopsis, binocular, rivalry, hyperacuity, McCollough effect, textural grouping, border distinctness surface perception, monocular and binocular brightness precepts, filling-in, metacontrast, transparency, figural aftereffects, lateral inhibition within spatial frequency channels, proximity-luminance covariance, tissue contrast, motion segmentation, and illusory figures, as well as about reciprocal interactions among the hyper-columns, blobs, and stripes of cortical areas V1, V2, and V4. Monocular and binocular interactions between a Boundary Contour (BC) system and a Feature Contour (FC) System are developed. The BC System, defined by a hierarchy of oriented interactions, synthesizes an emergent and coherent binocular boundary segmentation from combinations of unoriented and oriented scenic elements.

37904 **(GSI—87-11, pp H2.1-H2.3) In vivo measurements of human tumour cell kinetics.** McNally, N.J.; Wilson, G.D. (Mount Vernon Hospital, Northwood (UK). Gray Lab.). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

5520 Public Health

REFER ALSO TO CITATION(S) 36492, 37261, 37682, 37741, 37742, 37802, 37803, 37804, 37805, 37806, 37807, 37923, 38012

37905 **(PB—88-188669/XAB) Current Intelligence Bulletins: summaries, September 1987.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1987. 29p. (DHHS/PUB/NIOSH—87/118). NTIS, PC A03/MF A01.

See also PB—87-163101.

Brief summaries of 49 NIOSH Current Intelligence Bulletins were provided in a cumulative listing. Permissible Exposure Limits were included where applicable, and notes were provided with some summaries indicating further action or data since original publication. Topics covered include chloroprene, trichloroethylene, ethylene-dibromide, chrome pigment, asbestos, hexamethylphosphoric-triamide, polychlorinated-biphenyls, 4,4'-diaminodiphenylmethane, chloroform, radon daughters, dimethylcarbamoyl-chloride, diethylcarbamoyl-chloride, explosive azide hazard, arsenic, nitrosamines, metabolic precursors of beta-naphthylamine, 2-nitropropane, acrylonitrile, 2,4-diaminoanisole, tetrachloroethylene, trimellitic-anhydride, ethylene-thiourea, ethylene-dibromide, disulfiram, dyes, ethylene-dichloride, chloroethanes, vinyl halides, glycidyl ethers, epichlorohydrin, smoking, arsine, radiofrequency sealers, formaldehyde, ethylene-oxide, silica flour, vibration syndrome, glycol ethers, 2,3,7,8-tetrachlorodibenzo-p-dioxin, 1,3-butadiene, cadmium, monohalomethanes, dinitrotoluenes, methylene-chloride, 4,4'-methylenedianiline, organic solvents, and injuries and amputations from working with power presses.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 35600, 35961, 35968, 36000, 37728, 37923

37906 **(INIS-BR—978) Some biologic aspects of Periplaneta americana (L.,1758) (Blatoides, Blatidae).** Lopes, L.A.; Walder, J.M.M.; Wiendl, F.M.; Arthur, V. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702752/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37907 **(INIS-BR—979) Populational dynamic of Ceratitis capitata (Wied.,1824) (Dip., Tephritidae) in citrus culture.** Walder, J.M.M. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702753/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37908 **(INIS-BR—980) Study of soil entomofauna of a Citrus orchard in Piracicaba, S.P. (Brazil).** Silva, E.B. da; Walder, J.M.M.; Martins, A.L. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702754/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37909 **(INIS-BR—981) Artificial diet for mass rearing of Ceratitis capitata (Wied., 1824) (Diptera, Tephritidae).** Walder, J.M.M.; Wiendl, F.M.; Arthur, V.; Lopes, L.A. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702755/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37910 **(INIS-BR—982) Desinfestation of mangoes, Mangifera indica L., and papayas, Carica papaya L., by gamma radiation , against Ceratitis capitata (Wiedemann, 1824) (Diptera-Tephritidae). Previous note.** Domarco, R.E.; Walder, J.M.M.; Wiendl, F.M.; Arthur, V. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702756/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37911 **(INIS-BR—983) Use of radiophosphorus (^{32}p) dispersion studies of adults of Sphemophorus levis vauri, 1978 (Col., Curculionidae) in sugar-cane culture.** Arthur, V.; Walder, J.M.M.; Wiendl, F.M.; Precetti, A.C.A.M.; Teran, O.F.; Henrique, B.C. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702757/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37912 **(INIS-BR—984) Effect of ^{32}p radioisotope in the fecundity of the green aphid Schizaphis graminum (Rondani, 1852) (Homoptera, Aphididae). Previous Note.** Corso, R.L.; Walder, J.M.M.; Silva, A.C. da. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702758/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37913 **(INIS-BR—985) Use of ^{32}p radiotracer for evaluate the difference of consumption between Eriopis conexa (Germar, 1824) and Cycloneda sanguinea (L., 1763) (Coleoptera, Coccinellidae), both predators of green aphid Schiszaphis graminum (Rondani, 1852) (Homoptera, Aphididae) in graniferous sorghum, under camp conditions. Previous Note.** Corso, R.L.; Walder, J.M.M.; Arthur, V. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702759/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37914 **(INIS-BR—986) Use of pupae of Musca domestica L., irradiated by gamma rays (^{60}Co), in rearing of parasites of Spalangia spp., Muscidifurax raptor Girault and Sanders e Pachycrepoides vindemiae Rondani.** Itepan, N.M.; Berti Filho, E.; Costa, V.A.; Arthur, V.; Costa, N. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702760/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37915 **(INIS-BR—987) Fertility of Chrysomya megacephala (Diptera, Calliphoridae) treated by gamma radiation - Cobalt 60.** Garcia, C.R.; Wiendl, F.M. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702761/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37916 **(INIS-BR—1090) Differential densitometry in radiographies. Comparative study in osteotomies.** Louzada, M.J.Q.; Paulin, J.B.P.; Xavier, C.A.M.; Valeri, V. (Sao Paulo Univ., Ribeirao Preto (Brazil). Faculdade de Medicina). 1987. 2p. (In Portuguese). (CONF-8709281—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702787/JAW.

From 10. Brazilian congress on biomedical engineering; Rio de Janeiro, Brazil (14 Sep 1987).

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 36517, 37492, 38635, 38636

37917 **(AD-A—190455/6/XAB) Radiation-induced germ-cell mutations - their detection and modification. Technical report, 1 April 1983-30 June 1987.** Goldstein, L.S. (California Univ., San Francisco (USA)). 30 Jun 1987. 80p. NTIS, PC A05/MF A01.

Mutagenesis by densely ionizing radiation represents a significant long-term hazard to the individual. Few data are available to describe the dose-response aspect of mutation induction by either accelerated charged particles or fission-spectrum neutrons in mammalian germ cells. To address this question, an in-vitro assay of dominant lethal mutations was undertaken for animals exposed to either of these radiation sources. Special emphasis was placed on the action in spermatogonial stem cells. The data indicate that mutations were induced as a linear function of dose and there was no evidence of a threshold. Mutagenesis was also detected in females given x radiation. The induction curve had an initial steep linear aspect and then a less-steep slope. As with male germ cells, there was no evidence of a threshold. The in vitro dominant lethal data were compared to various cytogenetic assays and were found to be more sensitive indicators of mutation. In preliminary studies, the rate of stable mutagenic damage appeared to be modifiable by pretreatment with chemotherapeutic drugs. Because the radiation sources chosen for this study are thought to be the most efficient for mutation induction, the values obtained may describe the upper limits of exposure for this endpoint. As applied to risk estimation, these data should be considered relative to the normal risk encountered and accepted by the population at large.

37918 **(AD-A—190508/2/XAB) Anthropomorphic phantom radiation dosimetry at the NATO standard reference point at Aberdeen Proving Ground.** Cousins, T.; Rushton, L.P. (Defence Research Establishment, Ottawa, Ontario (Canada)). Apr 1987. 30p. (DREO—968). NTIS, PC A03/MF A01.

Abstract in French.

As part of the NATO Dosimetry Intercomparison Project, a series of experiments were conducted at Aberdeen Proving Ground in September 1986 in order to determine neutron and gamma-ray doses delivered to various internal and external locations on an anthropomorphic phantom from a fission source. Thus, the effect of such parameters as self-shielding by the body on dosimeter reading may be determined. The results will be used eventually to validate computer simulations of the Aberdeen environment in order to understand completely the correlation between dosimeter reading and bone marrow dose, or other parameters relating to performance decrement.

37919 **(BMU—1987-149) Blood stem cell changes as an indicator of a radiation exposure and prognostic relevance. Report for the period 1.10.1980 - 30.9.1986. Final report.** Fliedner, T.M.; Nothdurft, W. (eds.). (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Ulm Univ. (Germany, F.R.). Abt. Klinische Physiologie und Arbeitsmedizin). 1987. 26p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen,, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The aim of the research study was to examine to what extent changes in the blood picture will allow conclusions to be drawn for the degree of damage to the bone marrow and for the recovery capacity of haemopoiesis following different radiation exposures. Changes in the granulocyte counts allow to see direct relationships to the bone marrow injury and regeneration processes at various radiation exposures. The same applies to the platelet count. Under specific exposure conditions, however, the lymphocyte concentration alternatives are hardly suitable for a differentiated assessment of the functional state of blood cell formation.

37920 **(BNL—40978) Background mortality information: Methodology and example results using three environmental assessment reference repository site data bases.** Grimshaw, C.A. (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007546/JAW.

Cancer mortality data were examined as part of an evluation to assess health impacts of possible radiation releases from an operating geologic repository. Tables of the general results obtained are given. This report gives an example of the type of results that can be achieved by running the US mortality and population data base analysis computer package. 5 refs., 1 fig., 7 tabs.

37921 **(CEA-R—5424) Studies and activities in the field of chemical toxicology carried out by the service d'hygiene industrielle.** Chalabreysse, J.; Archimbaud, M.; Teulon, F. and others. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France)). Feb 1988. 79p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753938/JAW.

The Service d'Hygiene Industrielle (Industrial hygiene service, Institute of protection and nuclear safety, Department of health protection - IPSN-DPS) has acquired an unquestionable proficiency in chemical toxicology on account of 1) its missions of research on and monitoring of workers, working conditions and the environment on the Tricastin industrial complex and 2) of its actions of technical assistance to the CEA group and of valorization outside the group. The report presents how toxicological hazards originated from the use of chemical products by the nuclear industry are taken into consideration. A global methodology of assessment of chemical-toxicological hazards has been developed; it is based on the experience gained in various occupational branches (nuclear and non-nuclear industry, agriculture, administrations,...). The Service d'hygiene industrielle is developing R and D studies in the field of biology and analytical chemistry based on the present knowledge and doctrine in radiotoxicology (uranium especially). The contribution of radiation protection and radiotoxicology to non-nuclear industrial hygiene can thus be appreciated.

37922 **(CONF-8805105—1) Estimation of ^{244}Cm intake by bioassay measurements following a contamination incident.** Thein, M.; Bogard, J.S.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010140/JAW.

From 2. international conference on low level measurements of actinides and long-lived radionuclide in biological and environmental samples; Akita City, Japan (16 May 1988).

An employee was contaminated with radioactive material consisting primarily of ^{244}Cm and ^{240}Cm as a consequence of handling a curium nitrate solution at a reprocessing facility. In vivo gamma analysis and in vitro (urine and fecal) analysis were initiated soon after the incident. Further in vivo measurements were performed regularly through hour 528, and in vitro bioassay measurements were obtained through day 74. A sample of the curium solution from the workplace was obtained to confirm that the nitrate was the chemical form and to identify the curium isotopes present. The mass ratio of ^{244}Cm:^{248}Cm was determined to be 91:7. Diethylenetriaminepentaacetate (DTPA) was administered on hours 33 and 71. Observed excretion rates were consistent with available information for curium in the literature. In this paper, the results of the in vivo and in vitro measurements are presented and intake estimates for the incident are developed using various excretion rate functions. 11 refs., 3 figs., 2 tabs.

37923 **(DOE/AL/27458—T2) Shellfish depuration by gamma irradiation: Final report for the period October 1, 1985-September 30, 1986.** Beghian, L.; Melnick, J. (Lowell Univ., MA (USA). Radiation Lab.; Baylor Univ., Houston, TX (USA). Coll. of Medicine; National Marine Fisheries Service, Gloucester, MA (USA)). 1 Nov 1986. Contract FG04-84AL27458. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011140/JAW.

Irradiation of live bivalve molluscs is a promising new technique to reduce the public health threats of viral and bacterial pathogens in the consumption of raw shellfish. In studies conducted within the past year, live hardshelled clams and oysters were innoculated with Simian Rotavirus SA-11, Poliovirus I, and Hepatitis-A virus and treated with gamma ray ionizing radiation from University of Lowell/DOE 800,000 Curie ^{60}Co source over a dose range of 0.5--10 kiloGray (50--1000 kilorad) to determine the effectiveness of the process in eliminating viral activity and thus easing the potential viral health threats associated with uncooked bivalves. Two viral strains, SA-11 and Poliovirus I, were employed as models to perfect laboratory technique and to estimate the most appropriate range of dose exposures necessary for optimal inactivation of the infectious pathogen, Hepatitis A. Post-irradiation survivorship of the oysters and quahogs was assessed over a range of exposures, and showed an exceptionally high degree of radioresistance for these molluscan species. 7 refs., 7 figs., 14 tabs.

37924 **(DOE/CH/10330—1) Genetic effects of plutonium in Drosphila: Progress report, June 1987-April 1988.** Kale, P. (Alabama A and M Univ., Normal (USA). Dept. of Biology). 27 Jun 1988. Contract FG02-87CH10330. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011553/JAW.

The spontaneous mutation rate in our Drosophila is very low and does not vary from one experiment to another. These stocks are therefore quite suitable for comparisons with similar data from experiments with plutonium or alpha radiation.

37925 **(DOE/ER—60089-2) Studies of human mutation rates, December 1, 1985--November 30, 1986.** Neel, J.V. (Michigan Univ., Ann Arbor (USA). Dept. of Human Genetics). 1 May 1985. Contract AC02-82ER60089. 134p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88009918/JAW.

This program seeks to quantify native human mutation rates and to determine how man's activities may affect these rates. The program is divided into six tasks, i.e. The American Indian mutation rate, monitoring populations for frequency of mutation by electrophoresis of blood proteins, application of molecular biological approaches to the detection and study of mutational events in

human populations, development of two-dimensional electrophoresis for identification of mutant proteins, co-operative program with the Radiation Effects Research Foundation in Hiroshima and Nagasaki, Japan, and statistical problems associated with the estimation of mutation rates. Progress of each of the above tasks is related in detail. (DT)

37926 **(DOE/ER—60089-3) Studies of human mutation rates: Progress report.** Neel, J.V. (Michigan Univ., Ann Arbor (USA). Dept. of Human Genetics). 1 Jul 1988. Contract FG02-87ER60533. 29p. NTIS, PC A03;3. Order Number DE88009881/JAW.

Progress was recorded between January 1 and July 1, 1987 on a project entitled "Studies of Human Mutation Rates". Studies underway include methodology for studying mutation at the DNA level, algorithms for automated analyses of two-dimensional polyacrylamide DNA gels, theoretical and applied population genetics, and studies of mutation frequency in A-bomb survivors.

37927 **(DOE/ER/60369—T1) Mechanisms for Radon-222 transport in vascular plants, and uptake of radium-226 in C_3 and C_4 species: Final report for period August 5, 1985-December 31, 1987.** Lewis, B.G. (Northwestern Univ., Evanston, IL (USA)). May 1988. Contract FG02-85ER60369. 49p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011607/JAW.

Previous work in our laboratory had provided quantitation of plant exhalation of Radon-222. This present work focused on the mechanisms of the phenomenon. Experiments with radon diffusion through paraffin indicated that plant epicuticular wax would present essentially no barrier to radon unlike its effect on water vapor diffusion. Thus, radon and water transport in the plant appear to be decoupled primarily in the leaf mesophyll. Transport of radon from root to leaf appears to be primarily as convective flow in the xylem fluid, but diffusion of radon from the fluid into air spaces within the plant probably occurs. Experiments with plants in solution culture indicated that, generally, C_3 species tended to have higher tissue concentrations of Radium-226, but these differences were less marked, and could even be reversed, for C_3 and C/sub 4 plants within the same genus. Manipulating solution culture pH was not dramatically effective in reducing Radium-226 uptake. 8 refs., 3 figs., 6 tabs.

37928 **(DOE/ER/60502—2) The development of in vitro mutagenicity testing systems using T-lymphocytes: Progress report, November 1, 1987--May 31, 1988.** Albertini, R.J. (Vermont Univ., Burlington (USA)). May 1988. Contract FG02-87ER60502. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011141/JAW.

We have investigated the mutagenic effects of ionizing irradiations in human T-lymphocytes. These have included in vitro exposure of G_0 phase peripheral blood T-lymphocytes to gamma irradiation, with subsequent growth for phenotypic expression and selection of 6-thioguanine resistant (TG/sup r/) colonies to measure mutation induction at the hprt mutations. We have studied the DNA alterations in both in vivo and in vitro induced mutants by Southern blot analysis with an hprt cDNA probe in order to investigate the possible specificity of radiation damage. We have employed Southern blot analyses with T-cell receptor (TCR) gene probes in order to define the clonality of these mutants and allow definition of the mutation frequency underlying the measured mutant frequency. This approach has allowed us to define the molecular nature of mutations induced both in vivo and in vitro by ionizing radiation. Southern blot analysis of 70 in vitro mutant clones induced by 300 rads of gamma irradiation have shown them to be the result of 24 independent mutations by TCR gene rearrangement patterns. Eighteen (0.66) of these were found to have large hprt DNA alterations. Individuals therapeutically exposed to ionizing irradiations show higher TG/sup r/ mutant frequencies than those found in normal controls and a higher fraction of these mutants also contain hprt gene alterations detected by Southern blot analysis (0.34 vs. 0.10–0.15 in controls, respectively). The fraction of mutations which contain detectable DNA alterations is thus elevated after both in vitro and in vivo irradiation of the cells. Analysis of breakpoints in these mutants has allowed us to estimate the maximum size deletion recoverable at the hprt locus. 8 refs., 5 figs., 4 tabs.

37929 **(DOE/RL/11374—T1) Radiofrequency radiation-induced calcium-ion-efflux enhancement from human and other neuroblastoma cells in culture: [Final technical report].** Dutta, S.K.; Ghosh, B.; Blackman, C.F. (Howard Univ., Washington, DC (USA); Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). [1988]. Contract AI06-87RL11374. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011609/JAW.

In order to test the generality of radiofrequency-radiation-induced change in alternation of ^{45}Ca/sup 2{plus/} efflux from avian and feline brain tissues, human neuroblastoma cells were exposed to electromagnetic radiation at 147 MHz, amplitude modulated (AM) at 16 Hz, at specific absorption rates (SAR) of 0.1, 0.05, 0.01, 0.005, 0.001, and 0.0005 Wkg. Significant ^{45}Ca/sup 2{plus/} efflux was obtained at SAR values of 0.05 and 0.005 Wkg. Enchanced efflux at 0.05 Wkg peaked at the 13-to-16 Hz and at the 57.5-to-60 Hz modulation ranges. A Chinese hamster-mouse hybrid neuroblastoma was also shown to exhibit enchanced radiation-induced ^{45}Ca/sup 2{plus/} efflux at an SAR of 0.05 Wkg, using 147 MHz, AM at 16 hz. These results confirm that amplitude-modulated radiofrequency radiation can induce response in cells of nervous tissue origin from widely different animal species including humans. The results are also consistent with reports of similar findings in avian and feline brain tissue reported by others and indicate the general nature of the phenomenon. 9 refs., 3 tabs.

37930 **(EUR—10953) Radiation protection progress report 1986.** (Commission of the European Communities, Luxembourg). 1987. 1731p. Commission of the European Communities, Luxembourgh.

The progress report of the radiation protection programme outlines the research work carried out in 1986 under contracts between the Commission of the European Communities and research groups in the Member States. Results of more than 330 projects are reported. They are grouped into six sectors: radiation dosimetry and its interpretation, behaviour and control of radionuclides in the environment, non-stochastic effects of ionizing radiation, radiation carcinogenesis, genetic effects of ionizing radiation, evaluation of radiation risks and optimization of protection. Within the framework programme, the aim of this scientific research is to improve the conditions of life with respect to work and protection of man and his environment and to assure a safe production of energy, i.e.: (i) to improve methods necessary to protect workers and the population by updating the scientific basis for appropriate standards, (ii) to prevent and counteract harmful effects of radiation, (iii) to assess radiation risks and provide methods to cope with the consequences of radiation accidents.

37931 **(GSF-BPT—2/87) Effect of enhanced UV-B radiation and of other stress factors on marine phytoplankton. Final report.** Doehler, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften). 1987. 95p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753545/JAW.

The impact of UV-B stress on the uptake of inorganic nitrogen compounds by several marine diatoms has been studied. Synedra has shown specially strong sensitivity to UV-B radiation, whereas the Lithodesmium species isolated in Japan has been less damaged in the experiments. Uptake of ^{15}N-ammonium is much more affected than the uptake of ^{15}N-nitrate. Experiments with Ditylum have shown that exposure to UV-B radiation at different times of the day produces effects. Different response to UV-B exposure with simultaneous exposure to monochromatic light has likewise been observed. The reversible UV-B induced damage observed after the first day of exposure becomes irreversible upon second exposure. The pattern of ^{14}C- and ^{15}N-labelled amino acids is significantly changed by UV-B stress. (orig.KG) With 50 refs., 15 tabs., 51 figs..

37932 **(GSI—87-11) Third workshop on heavy charged particles in biology and medicine. Book of abstracts.** Kraft, G.; Grundinger, U. (eds.). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jul 1987. 241p. (CONF-870779—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW.

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

The book of abstracts contains 67 papers presented at the workshop. Main topics are: Physics, chemistry, DNA, cell biology, cellular and molecular repair, space biology, tumor and tissue biology, predictive assays, cancer therapy, and new projects. Separate entries in the database are prepared for all of these papers.

37933 (GSI—87-11, pp B2.1-B2.2) **Theoretical and experimental studies of prompt and delayed DNA strand breaks.** Chatterjee, A.; Roots, R.; Koehl, P.; Holley, W.; Chakravorti, S. (Lawrence Berkeley Lab., CA (USA). Div. of Biology and Medicine). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37934 (GSI—87-11, pp B4.1-B4.3) **Free radicals in solid DNA induced by heavy ion bombardment: Quantitative and structural aspects.** Huettermann, J.; Schaefer, A. (Universitaet des Saarlandes, Homburg/Saar (Germany, F.R.). Fachrichtung Biophysik und Physikalische Grundlagen der Medizin). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37935 (GSI—87-11, pp B5.1-B5.5) **Induction of single and double strand breaks in SV40 DNA in solution.** Kraft, G.; Kraft-Weyrather, W.; Lang, A.; Roots, R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lawrence Berkeley Lab., CA (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37936 (GSI—87-11, pp B6.1-B6.4) **Heavy-ion induced single- and double-strand breaks in SV40 DNA - in vitro and in vivo measurements.** Lang, A.; Kraft, G. Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37937 (GSI—87-11, pp B7.1) **Oxygen effect on DNA double strand breaks in human melanoma cells induced by alpha-particles.** Kaneko, I.; Eguchi-Kasai, K.; Kosaka, T.; Maruhashi, A. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37938 (GSI—87-11, pp C1.1-C1.4) **Inactivation, chromosome aberrations and strand break induction as function of radiation quality.** Kraft, G.; Kraft-Weyrather, W. Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37939 (GSI—87-11, pp C2.1) **Lethal effects of fast atomic nuclei of the same velocity but different charge.** Blakely, E.A.; Chang, P.Y.; Lommel, L.; Tobias, C.A. (Lawrence Berkeley Lab., CA (USA). Div. of Biology and Medicine). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37940 (GSI—87-11, pp C3.1-C3.3) **Chromosomal damage as a function of radiation quality.** Geard, C.R. (Columbia Univ., New York (USA). Radiological Research Lab.). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37941 (GSI—87-11, pp C4.1-C4.2) **Transformation in mammalian cells by heavy ion radiation.** Yang, T.C.; Tobias, C.A. (Lawrence Berkeley Lab., CA (USA). Div. of Biology and Medicine). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37942 (GSI—87-11, pp D1.1) **Cell biology at the RIKEN accelerators.** Kaneko, I.; Eguchi-Kasai, K.; Takahashi, T. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37943 (GSI—87-11, pp D2.1-D2.2) **Heavy ion induced transcription inhibition in yeast cells and its recovery.** Weber, K.J.; Schneider, E.; Kiefer, J. (Giessen Univ. (Germany, F.R.). Strahlenzentrum). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37944 (GSI—87-11, pp D3.1-D3.4) **Heavy ion effects in plant seeds and spores.** Bork, U.; Gartenbach, K.; Koch, C.; Kranz, A.R. (Frankfurt Univ. (Germany, F.R.). Botanisches Inst.). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37945 (GSI—87-11, pp D4.1-D4.3) **Inactivation and transformation of C3H10T1/2 cells by heavy ions.** Hieber, L.; Ponsel, G.; Kellerer, A.M. (Wuerzburg Univ. (Germany, F.R.). Inst. fuer Medizinische Strahlenkunde). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37946 (GSI—87-11, pp D5.1-D5.5) **Mutation induction in Ames tester strains after heavy ion exposure.** Thomas, W.H.; Roos, H.; Fitzek, M.; Greinert, R.; Kellerer, A.M. (Wuerzburg Univ. (Germany, F.R.). Inst. fuer Medizinische Strahlenkunde). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37947 (GSI—87-11, pp D6.1-D6.3) **Genetic and developmental effects of heavy ion radiation in the nematode C. elegans.** Nelson, G.A.; Coohill, T.P.; Marshall, T.M.; Schubert, W.W.; Benton, E.V. (Jet Propulsion Lab., Pasadena, CA (USA); San Francisco Univ., CA (USA). Dept. of Physics). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37948 (GSI—87-11, pp D7.1) **Mutation induction in mammalian cells by heavy ions.** Kranert, T.; Schneider, E.; Kiefer, J. (Giessen Univ. (Germany, F.R.). Strahlenzentrum). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37949 (GSI—87-11, pp D8.1-D8.2) **Why does the RBE for cell survival change with LET?.** Goodwin, E.H.; Blakely, E.A.; Tobias, C.A.; Ivery, G.P.; Chang, P.Y.; Lommel, L. (Lawrence Berkeley Lab., CA (USA). Div. of Biology and Medicine). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37950 (GSI—87-11, pp D9.1-D9.4) **Flow cytometric detection of chromosome aberrations and micronuclei in irradiated mammalian cells.** Nuesse, M.; Kraemer, M.; Egner, H.J. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Frankfurt am Main (Germany, F.R.)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37951 (GSI—87-11, pp D10.1-D10.2) **Chromosomal lesions induced by neon ions in human lymphocytes at GO phase.** Sabatier, L.; Al Achkar, W.; Luccioni, C.; Dutrillaux, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37952 (GSI—87-11, pp D11.1-D11.9) **Investigation of lethal and mutagenic effects of γ-rays and high-LET particles in Dubna.** Krasavin, E.A.; Kozubek, S.; Amirtayev, K.G.; Bonev, M.; Tokarova, B.; Govorun, R.D.; Nasonova, E.A.; Lobatchevskij, P.N.; Tcherevatenko, A.P. (Joint Inst. for Nuclear Research, Dubna (USSR)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

Extensive investigations of lethal effects of γ-rays and high LET particles have been performed at different levels of cell organisation and under various conditions in Dubna. Cell survival curves were measured for bacterial, yeast, and mammalian cells. In order to explain the observed curves, a program calculating energy fluctuations in sensitive microvolumes was developed. The program of biological investigations in JINR, Dubna, is substantially extended now. Beside lethal effects the mutagenic action of various types of ionising beams is studied. A new mighty accelerator has been reconstructed. It is a synchrocyclotron with the maximum output of about 50 μA of 60 MeV protons. The machine gives proton, neutron and negative pion beams for clinical purposes. There is an extensive biological program on the accelerator including investigation of lethal, mutagenic and carcinogenic effects.

37953 (GSI—87-11, pp D13.1-D13.2) **Effect of heavy ions on microorganisms - track structure theory and single-particle experiment.** Takahashi, T.; Yatagai, F.; Katayama, T.; Kaneko, I.; Tabata, T. (Institute of Physical and Chemical Research, Wako, Saitama (Japan); Radiation Center of Osaka Prefecture, Sakai (Japan)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37954 (GSI—87-11, pp D14.1-D14.3) **Action of heavy ions on bacterial cells with different radiosensitivities.** Schaefer, M.; Facius, R. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (DFVLR), Koeln (Germany, F.R.). Inst. fuer Flugmedizin). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37955 (GSI—87-11, pp D15.1-D15.4) **Chromosome aberration induced by heavy charged particles.** Ritter, S.; Kraft-Weyrather, W.; Scholz, M.; Kraft, G. Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37956 (GSI—87-11, pp D16.1-D16.4) **Mutation induction by low doses of fast neutrons, X-rays, or selected heavy ions in a human B-lymphoblastoid cell line.** Kronenberg, A.; Little, J.B. (Harvard School of Public Health, Boston, MA (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37957 (GSI—87-11, pp D17.1-D17.4) **RBE/dose relationships for 650 MeV helium ions, californium-252 neutrons, and fast neutrons obtained using 3 criteria in vegetal systems.** Richard, F.; Gueulette, J.; Wambersie, A.; Dutreix, A.; Dam, J. van. (Louvain Univ., Brussels (Belgium). Cliniques Universitaires St. Luc; Institut Gustave Roussy, 94 - Villejuif (France); Academisch Ziekenhuis Saint Rafael, Louvain (Belgium)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37958 (GSI—87-11, pp E1.1-E1.2) **Repair processes in mammalian cells after exposure to radiation of high LET.** Iliakis, G. (Thomas Jefferson Univ., Philadelphia, PA (USA). Dept. of Radiation Therapy and Nuclear Medicine). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37959 (GSI—87-11, pp E2.1-E2.5) **Cell-cycle responses of the L5178Y S/S murine leukemic lymphoblast to heavy ions and their radiobiological significance.** Lett, J.T. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37960 (GSI—87-11, pp E3.1) **Misrepair in DNA fragments in mammalian cells.** Ngo, F.Q.H.; Jia Xianli; Roberts, W. (Cleveland Clinic Foundation, OH (USA). Research Inst.). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37961 (GSI—87-11, pp E4.1-E4.4) **Heavy ion induced strand breaks and their repair in diploid lens epithelial cells.** Heilmann, J.; Rink, H. (Bonn Univ. (Germany, F.R.). Inst. fuer Strahlenbiologie). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37962 (GSI—87-11, pp F1.1-F1.4) **Radiation effects in space.** Fry, R.J.M. (Oak Ridge National Lab., TN (USA). Biology Div.). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37963 (GSI—87-11, pp F2.1) **Limits of radiation exposure for astronauts and implication of changes in Q.** Nachtwey, D.S. (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37964 (GSI—87-11, pp F3.1-F3.3) **Results of radiobiological experiments in space.** Buecker, H.; Horneck, G. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (DFVLR), Koeln (Germany, F.R.). Inst. fuer Flugmedizin). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37965 (GSI—87-11, pp F4.1) **Early and late mammalian responses to heavy charged particles.** Ainsworth, E.J. (Lawrence Berkeley Lab., CA (USA). Div. of Biology and Medicine). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37966 (GSI—87-11, pp G1.1-G1.4) **Potentially lethal damage repair and repopulation kinetics in rat rhabdomyosarcoma tumors following high-LET radiation.** Curtis, S.B.; Afzal, S.M.J.; Tenforde, T.S. (Lawrence Berkeley Lab., CA (USA). Div. of Biology and Medicine). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37967 (GSI—87-11, pp G2.1-G2.6) **Effect of 470 MeV argon beam on a radioresistant murine fibrosarcoma.** Ando, Koichi; Ishii, Takeshi; Satoh, Shinichiro; Ludewigt, B.A.; Ainsworth, E.J.; Tobias, C.A. (National Inst. of Radiological Sciences, Chiba (Japan). Div. of Clinical Research; Lawrence Berkeley Lab., CA (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37968 (GSI—87-11, pp G3.1-G3.3) **Ocular pathogenesis from accelerated heavy ion exposure.** Worgul, B.V. (Columbia Univ., New York (USA). Eye Radiation Research Lab.). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37969 (GSI—87-11, pp G4.1-G4.3) **Neon irradiation of the rat spinal cord.** Rodriguez, A.; Alpen, E.L.; DeGuzman, R.J. (Lawrence Berkeley Lab., CA (USA). Div. of Biology and Medicine). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37970 (GSI—87-11, pp G5.1-G5.4) **Late effects of particle radiation on kidney function.** Alpen, E.L.; Powers-Risius, P.; DeGuzman, R. (Lawrence Berkeley Lab., CA (USA). Div. of Biology and Medicine). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37971 (GSI—87-11, pp H3.1-H3.4) **Sensitizer-adduct technique for measurement of human tumor hypoxic fractions: A predictor of patients who might benefit from heavy-charged particle therapy.** Chapman, J.D.; Urtasun, R.C.; McKinnon, S.L.; Meeker, B.E.; Koch, C.J.; Raleigh, J.A.; Franko, A.J. (Alberta Univ., Edmonton (Canada). Dept. of Radiation Oncology; Alberta Univ., Edmonton (Canada). Cross Cancer Inst.; Alberta Univ., Edmonton (Canada). Dept. of Radiology and Diagnostic Imaging). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

37972 (GSI—88-05-Prepr.) **Induction of chromosome aberrations in Chinese hamster cells after heavy ion irradiation.** Ritter, S.; Kraft, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jan 1988. 8p. (CONF-8710285—). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

From NATO advanced study institute on terrestrial space radiation and its biological effects; Corfu, Greece (12 Oct 1987).

The induction of structural chromosome changes in V 79-Chinese hamster cells following heavy ion irradiation is studied. Asynchronous exponentially growing cells are exposed to the heavy ion beams at the Unilac, Darmstadt and the Ganil, Caen. The induction of chromosome aberrations was measured as a function of time after exposure.

37973 (HEHF—54-87) **United States Transuranium Registry: Annual report, October 1, 1986 through September 30, 1987.** Swint, M.J.; Kathren, R.L. (Hanford Environmental Health Foundation, Richland, WA (USA)). Apr 1988. 37p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011047/JAW.

This report summarizes progress of the United States Transuranium Registry for the 1987 fiscal year, including as an appendix the observations and recommendations of the Scientific Advisory Committee. Completion of the first phase of the analytical laboratory intercomparison study has led to verification and reduction in the uncertainty of the values for two NBS Standard Reference Materials. The human arm phantom built as an in-vivo counting calibration standard for Am-241 has been completed and made available for use by other laboratories, along with the previously completed skull phantom. Preliminary evaluation of USTR Case 193, a whole body plutonium case, was completed and reported at a national scientific meeting. The autopsy results tend to verify improvements in recent biokinetic models. Tissue donation was received from a former Hanford worker who received an extensive internal deposition of Am-241 from an explosion in a glove box 10 years prior to death from heart disease. Because of the extraordinary nature of this case, plans are being developed for interlaboratory collaboration to ensure that the knowledge derived from evaluation of this case will be maximized.

37974 (INIS-BR—977) **Gamma radiation effects on the pupa viability and the longevity of adult screw-worm flies chrysomya megacephala (Diptera, Calliphoridae).** Garcia, C.R.; Wiendl, F.M. (Sociedade Entomologica do Brasil, Porto Alegre). 1987. 1p. (In Portuguese). (CONF-8707164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702751/JAW.

From 11. Brazilian congress of entomology; Campinas, Brazil (12 Jul 1987).

37975 **(INIS-mf—11047) Radiation.** (Consumer's Association of Ireland, Dublin). Sep 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702327/JAW.

From Consumer Choice (Sep 1987). ISSN 0790-486x.

Radiation has come to represent one of the major health hazards to mankind. This report explains what it is and why it concerns us.

37976 (INIS-mf—11233, pp 79) **Ional changes after application of FCOL and its modification by EDTA: study in irradiated and non-irradiated rats.** Zernicek, D.; Vasku, J.; Dostal, M.; Urbanek, E.; Ahlers, I. (Universita J.E. Purkyne, Brno (Czechoslovakia). Lekarska Fakulta; Univerzita P.J. Safarika, Kosice (Czechoslovakia). Katedra Vseobecnej Biologie). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37977 **(INIS-mf—11233) Chelating agents in pharmacology, toxicology and therapeutics. Abstracts of 2nd international symposium.** (Ceskoslovenska Lekarska Spolecnost J.E. Purkyne, Prague). 1987. 79p. (CONF-8708259—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW.

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

The proceedings contain 71 abstracts of papers. Fourteen abstracts were inputted in INIS. The topics covered include: the effects of chelating agents on the retention of ^{63}Ni, ^{109}Cd, ^{203}Hg, ^{144}Ce, ^{95}Nb and the excretion of ^{210}Po, ^{63}Ni, ^{48}V, ^{239}Pu, ^{241}Am, ^{54}Mn; the applications of tracer techniques for studies of the efficacy of chelation therapy in patients with heart and brain disorders; and the treatment of metal poisoning with chelating agents. (J.P.).

37978 (INIS-mf—11233, pp 26) **Decreasing the risk from Pu-239 and Am-241 via chelation.** Mays, C.W.; Taylor, G.N.; Lloyd, R.D.; Bruenger, F.W. (Utah Univ., Salt Lake City (USA). Radiobiology Div.). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37979 (INIS-mf—11233, pp 49) **Radon decay products: DMPA decreases tissue poloaium-210.** Aposhian, M.M.; Aposhian, H.V.; Domingo, J.L.; Llobet, J.M.; Zheng Wei; Dart, R.C. (Arizona Univ., Tucson (USA)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37980 (INIS-mf—11233, pp 51) **Effect of bis(hydroxyethyl)dithiocarbamate on the excretion of ^{63}Ni in rats.** Bittnerova, D.; Blaha, K. Jr.; Cikrt, M.; Babicky, A. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia); Ceskoslovenska Akademie Ved, Prague. Fyziologicky Ustav). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37981 (INIS-mf—11233, pp 57) **Desferrioxamine and CaDTPA in indium intoxication.** Eybl, V.; Koutenska, M.; Koutensky, J.; Aaseth, J. (Karlova Univ., Plzen (Czechoslovakia). Lekarska Fakulta; Hedmark Central Hospital, Elverum (Norway)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37982 (INIS-mf—11233, pp 60) **Dynamics of whole body retention of repeated internal contamination with ^{95}Nb and ^{144}Ce radioisotopes in mice.** Gachalyi, A.; Namenyi, J.; Szegedi, I.; Varga, P.L. (National Research Institute for Radiobiology and Radiohygiene, Budapest (Hungary)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37983 (INIS-mf—11233, pp 69) **Effect of DTPA and mucosolvin treatment on the lung clearance of emphysematous rats exposed to ^{144}Ce.** Namenyi, J.; Gachalyi, A.; Szegedi, I.; Varga, L.P. (National Research Institute for Radiobiology and Radiohygiene, Budapest (Hungary)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37984 (INIS-mf—11233, pp 70) **Effect of ascorbic acid and desferrioxamine on the excretion and distribution of ^{48}V.** Nerudova, J.; Lepsi, P.; Blaha, K. Jr.; Cikrt, M. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37985 (INIS-mf—11233, pp 74) **Pharmacological studies on catecholamic acid - an efficient chelating agent for metal mobilization.** Tao, Z.Q.; Xu, X.H.; Yan, X.M.; Chen, Z.J.; Zhang, J.S.; Liang, Y.Y.; Hsieh, Y.Y. (Academia Sinica, Shanghai (China). Shanghei Institute of Materia Medica). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

37986 **(ISH—73) Analysis of leukemia deaths in Bavaria in the period 1976-1981. Pt. 1. Basis, methodology and realisation, analysis of patients' medical records.** Grosche, B.; Hinz, G.; Kaul, A.; Tsavachidis, C. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jun 1987. 188p. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

This volume is intended to give a survey of the quality of the collected data and a description. It is also intended to show on what assumptions the existing data can be used for a description of the regional distribution of leukemia deaths in Bavaria. The question whether an analysis of mortality can give information on morbidity remains open. Due to discussions on the possible connection between the operation of nuclear plants and the increase in leukemia, the Institute of Radiation Hygiene of the West German Department of Health carried out an analysis of leukemia deaths in Bavaria, on behalf of the Bavarian Ministry of Development and the Environment.

37987 **(ISH—98) Literature study on the physiology of cobalt.** Erzberger, A. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Dec 1986. 71p. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

This literature study analyses the metabolism of cobalt in the human body, focussing on its resorption and the influence of various parameters like its chemical form, antagonisms, etc. on the level of resorption rate. The value currently recommended by ICRP for

resorption rates (f_1 factor) of 0,3 or 0,05 for man is examined for its confirmation or non-confirmation in literature.

37988 **(ISH—105) Model for calculating the aerosol deposition in the human respiratory tract, with particular regard to children and infants.** Hornik, S.; Roedler, H.D.; Gerich, B. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jan 1987. 55p. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

For this research project, the deposition of inhaled aerosols in the total lung of adults and also in lung compartments has been calculated as a function of particle diameter, applying various calculation models and the resulting equations. The models and equations that best described the experimental results have then be applied to calculate the deposition in infants and ten-year-old children. The results obtained show that for children and infants, radiation dose calculations for inhaled radioactive aerosols of an activity of 1 μm can be done using the values determined for the deposition in adults. In the case of larger particle diameters, with a median aerodynamic diameter of 8 μm for example, calculations for infants have to take into account the increased tracheobronchial deposition, and calculations for children have to consider increased pulmonary deposition.

37989 **(ISH—111) Biological indicators of radiation exposure - serum amylase increase following irradiation of salivary glands.** Hofmann, R.; Pufal, D.; Boegl, W.; Willich, N.; Westhaus, R. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene; Klinikum Grosshadern, Muenchen (Germany, F.R.). Radiologische Klinik und Poliklinik). (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene; Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jun 1987. 81p. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

In this paper, an isoenzyme test is described which enables the proteins of pancreas to be differentiated from those of the salivary glands. This isoenzyme test, in combination with an antibody lipase test which inturn is sensitive to the pancreatic enzyme triacylglycerinlipase, has been used to examine a total of the 42 patients under radiation therapy. 25 of these patients had been subjected to partial body exposure of the head region and 17 to whole body exposure. The results show that the amount of activity increase depends upon the dose to the salivary glands and that almost exclusively the isoenzymes of these organs are responsible for the radiation-induced activity increase in the serum. The isoenzyme test proved to be a good approach in cases where pathogenic variations in the serum α-amylase activity concerning primarily the pancreatic glands had to be differentiated from radiation-induced variations.

37990 **(JINR-R—19-87-720) Radiosensitivity - let dependence in yeast. Effect of additional growth and their contribution in radioresistance and shape of survival curve in diploid yeast.** Lobachevskij, P.N.; Mishonova, V.B.; Cherevatenko, A.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702949/JAW.

A study was made of the contribution of additional growth effect (AGE) in survival of diploid yeast Saccharomyces cerevisiae and the influence of AGE on the shape of survival curve of cells, exposed to radiations with different linear energy transfer (LET). AGE was shown to be only factor determining the sigmoid shape of survival curve of diploid yeast, exposed to radiations with a high LET. The contribution of AGE in survival decreases by increasing LET, being conditioned by factors of physical and geometrical nature. 10 refs.; 1 fig.

37991 **(LUSG-WP—480) Child leukaemia around Sellafield: what Seascale said about the Black Report.** Macgill, S.M. (Leeds Univ. (UK). School of Geography). Jul 1986. 46p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The paper investigates reaction to the Black Report by the inhabitants of Seascale, the community whose situation - in terms of leukaemia incidence and proximity to Sellafield - was the focus of interest of that Report. The paper draws on an original interview-based social survey among the inhabitants of Seascale. As well as routine examination of response frequencies, a new methodological tool for reconstructing aggregate patterns of a large number of multiple character responses (from the Galois connections between response categories) is used as primary basis for interpretative analysis. It is found that the Black Report was received in Seascale with a mixture of confusion, satisfaction, deferred judgement and sharp criticism, and implications of this finding for the risk perception research field, as well as for policy makers, are brought out.

37992 **(NCRP—90) Neptunium: Radiation protection guidelines.** (National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). 28 Feb 1988. 119p. National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814;1. Order Number TI88010165/JAW.

The present report reviews the current knowledge of neptunium in areas which are important to radiation protection and makes recommendations on radiation protection guidelines. The report briefly reviews the chemical and physical properties of neptunium, the sources of neptunium in the environment, and potential pathways to man. The limited animal data on health effects are also examined. In addition, animal studies that may serve as a basis for predicting the metabolic behavior of neptunium in humans are considered. On the basis of the information examined, recommendations are made on the fraction of ingested neptunium absorbed from the gastrointestinal tract into blood (f_1). Finally, the report applies the available data to recommendations on radiation protection guidelines for neptunium.

37993 **(NRPB-R—217) Doses in radiation accidents investigated by chromosome aberration analysis. 18: a review of cases investigated, 1987.** Lloyd, D.C.; Edwards, A.A.; Prosser, J.S.; Moquet, J.E.; Finnon, P. (National Radiological Protection Board, Chilton (UK)). Mar 1988. 10p. H.M. Stationery Office, London, price Pound 4.00.

During 1987, 25 cases of suspected overexposure to ionising radiation were referred to the National Radiological Protection Board for investigation by cytogenetic analysis. Of the 25 cases, 14 were associated with industrial radiography, three were from major nuclear organisations and the remaining eight were from institutions of research, education or health. No biological indication of overexposure was found for 18 cases. Of the remaining seven, the numbers of chromosomal aberrations found indicated that their doses were small, with non exceeding 0.15 Gy. The chromosome data are compared with information from physical dosimetry and a brief summary is given of the circumstances of each case.

37994 **(NUREG/CP—0093) Ultrasensitive techniques for measurement of uranium in biological samples and the nephrotoxicity of uranium: Proceedings.** Kathren, R.L.; Weber, J.R. (eds.). (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 170p. (CONF-851267—; PNL—6511). NTIS, PC A08/MF A01 - GPO;1. Order Number TI88010718/JAW.

From Meeting on ultrasensitive techniques for measurement of uranium in biological samples and the nephrotoxicity of uranium; Washington, DC, USA (3 Dec 1985).

Edited transcripts are provided of two public meetings sponsored by the Division of Radiation Programs and Earth Sciences of the Nuclear Regulatory Commission, Occupational Radiation Protection Branch. The first meeting, held on December 3, 1985, included nine presentations covering ultrasensitive techniques for measurement of uranium in biological specimens. Topics included laser-spectrometric techniques for uranium bioassay, correlation of urinary uranium samples with air sampling results in industrial settings, delayed neutron counting, laser-kinetic phosphometry, isotope dilution mass spectrometry, resonance ionization spectroscopy, fission track analysis, laser-induced fluorescence, and costs of sampling and processing. The nine presentations of the second meeting dealt with the nephrotoxicity of uranium. Among the topics presented were the physiology of the kidney, the effects of heavy metals on the kidney, animal studies in uranium nephrotoxicity, comparisons of kidney histology in nine humans, renal effects in

uranium mill workers, renal damage from different uranium isotopes, and Canadian studies on uranium toxicity. Discussions following the presentations are included in the edited transcripts. 30 refs., 9 figs., 9 tabs.

37905 **(PNL—SA-14760) Relationship between {bar Q} defined in terms of y for 1 μm sites and initial radiation damage.** Braby, L.A.; Wilson, W.E.; Metting, N.F. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 5p. (CONF-880404—11). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008196/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

The recent suggestion that quality factor (Q) be defined in terms of lineal energy (y) rather than LET (IN 86) requires specification of the diameter of the site to be used. Since present knowledge of the mechanisms leading to effects of radiation is insufficient to specify the exact site size, and arbitrary choice of site size must be made. A site size of one or two micrometers has been recommended because it can be simulated by tissue equivalent proportional counters, making Q a measurable quantity. However, it is not immediately obvious that y measured in a 1 μm diameter site is relevant to the biological effectiveness of different radiations. Monte Carlo track structure calculations have been used to determine the distribution of energy deposition for protons and electrons at a variety of energies in 10 nm and 1000 nm diameter sites. The results indicate that measurements using large sites can be used to provide a satisfactory estimate of energy deposition in small sites and can thus be used to predict biological effectiveness, even if the effect depends on the concentration of damage in very small sites. 6 refs., 3 figs.

37906 **(PNL-SA—15819) Evidence of lung cancer risk from animal studies.** Cross, F.T. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 17p. (CONF-880329—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009488/JAW.

From 24. annual meeting of the National Council on Radiation Protection and Measurement; Washington, DC, USA (30 Mar 1988).

Human epidemiological data provide the most important basis for assessing risks of radon exposures. However, additional insight into the nature of exposure-response relationships is provided by animal experimentation and dosimetric determinations. Animal studies have now been conducted for more than 50 years to examine the levels of pollutants in underground mines that were responsible for the respiratory effects observed among miners. This work has emphasized respiratory cancer and the interaction of radon with other agents, such as ore dust, diesel-engine-exhaust fumes and cigarette smoke. The more recent data on radon-daughter inhalation exposures were provided by two American research centers, The University of Rochester (UR) and the Pacific Northwest Laboratory (PNL), and by the Compagnie Generale des Matieres Nucleaires (COGEMA) laboratory in France. Approximately 2000 mice, 100 rats and 80 dogs were employed in the completed UR studies, begun in the mid 1950s; 800 hamsters, 5000 rats and 100 dogs in the ongoing PNL studies, begun in the late 1960s; and 10,000 rats in the ongoing COGEMA studies, also begun in the late 1960s. More complete updated biological effects, data resulting from chronic radon-daughter inhalation exposures of mice, hamsters, rats and beagle dogs were examined. Emphasis on the carcinogenic effects of radon-decay product exposure, including the influences of radon-daughter exposure rate, unattached fraction and disequilibrium, and co-exposures to other pollutants. Plausible values for the radon (radon-daughter) lifetime lung-cancer risk coefficients are also provided. 13 refs., 1 fig., 1 tab.

37907 (SSA—1987-TS-8, pp 23-24) **Improvement in radioprotective activity by incorporation of compounds in carriers.** Fatome, M.; Roman, V.; Laval, J.-D. (Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

Incorporation of radioprotectors in carriers such as liposomes, microspheres and ion-exchange resins generally leads to a radioprotective activity after oral delivery and to its extension for a few hours. Their strong hydrophilicity can require some alterations of the usual techniques and can lower the stability of the preparations.

37908 **(SSA—1987-TS-8) 1986 Scientific works.** (Centre de Recherches du Service de Sante des Armees, 75 - Paris (France)). 1987. vp. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88753490/JAW.

Items within the scope of EDB have been entered individually into the data base. (ACR)

37909 **(TsNIIATOMINFORM-ON—2) Evaluation of non-stochastic effects of small doses of internal irradiation at the level of entire organisms.** Dedov, V.I.; Stepanenko, V.F.; Norets, T.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Natsional'naya Komissiya po Radiatsionnoj Zashchite). 1987. 46p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702954/JAW.

The data presented concern the estimation of nonstochastic effects including: the changes in the functional state of neuroendocrine system induced by incorporation of radionuclides emitting both γ- and Auger-electrons or β-particles (^{75}Se, ^{35}S) in quantities producing mean absorbed doses close to maximum permissible limits for non-stochastic effects (mean dose 0.5 Gy for the whole body); the influence of hormonal homeosthasis on the vital activity of irradiated organism; the influence of biological (age and sex of animal), dosimetric and microdosimetric (for Auger emitters) factors on the effects of the irradiation. The results of the examination of neuroendocrine system as a whole give evidence of serious and long-term changes in its function as a result of comparatively low mean doses of internal irradiation (0.5 Gy for the whole body). The data contradict the existing opinion of low radiosensitivity of endocrine glands examined separately. The characteristics of functional state of neuroendocrine system are used as a sensitive and informative criterion for evaluation of biological effects of small doses of internal irradiation. The examination of changes in the functioning of neuroendocrine system together with the analysis of hormonedepended processes permit to estimate the functional-capacities of irradiated organism, its activity, especially in strained conditions. 29 refs.; 4 tabs.; 6 figs.

38000 **(UCRL—94519) The next decade in external dosimetry.** Griffith, R.V. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 40p. (CONF-861044—11). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008905/JAW.

From 25. Hanford Life Sciences symposium: radiation protection-a look to the future - celebrating four decades of research at Hanford; Richland, WA, USA (21 Oct 1986).

As the radiation protection community moves through the last half of the '80s and into the next decade, we can expect the requirements for external dosimetry to become increasingly more restrictive and demanding. As in other health protection fields, growing regulatory and legal pressures, together with a natural evolution in philosophy, require the health physicist to display an increasing degree of accountability, rigor, and professionalism. The good news is that, for the most part, the technology necessary to solve many of the problems will be available or not far behind. This paper describes anticipated technology. 66 refs., 10 figs.

38001 **Skeletal ^{212}Pb retention following ^{224}Ra injection: extrapolation of animal data to adult humans.** Schlenker, R.A. (Argonne National Lab., IL (USA)). *Health Physics;* **54**: No. 4, 383-396(Apr 1988).

Two methods of interspecies extrapolation, one based on a correlation of skeletal ^{212}Pb/^{224}Ra with body weight, the other based on the mechanistic relationship between skeletal ^{212}Pb/^{224}Ra and reciprocal bone surface-to-volume ratio, lead to the conclusion that the retention of ^{212}Pb in the adult human skeleton is approximately complete a few days after injection. The correlation-based method gives most probable values for ^{212}Pb/^{224}Ra of 1.0 and 1.1 at 2 d and 7 d after injection, compared with values of 1.05 and

1.27 expected at these same times if the retention of ^{212}Pb were complete from the time of injection and if no ^{212}Pb were in the injection solution. The range of values corresponding to one geometric standard error on either side of the most probable value is 0.87 to 1.21 at 2 d post-injection. With the method based on the reciprocal bone surface-to-volume ratio, the best estimate of $^{212}Pb/^{224}Ra$ at 2 d after injection is 0.88, equal to the value observed in young adult beagles. An alternative interpretation of the results of this latter method leads to the conclusion that retention is complete, with $^{212}Pb/^{224}Ra$ equal to 1.0 for a ^{212}Pb-free injection solution and 1.1 for a solution containing ^{212}Pb in secular equilibrium with ^{224}Ra. This work, which uses ^{224}Ra daughter product retention data from mice, rats and dogs following 224Ra injection, provides a scientific foundation for retention assumptions made in the calculation of mean skeletal dose for adult humans. There now appear to be few uncertainties in these latter dose values, stemming from inaccurate retention assumptions; but substantial uncertainties remain in the mean skeletal dose values for juveniles and in the endosteal tissue doses regardless of age.

38002 **Chemical exposures and central nervous system cancers: a case-control study among workers at two nuclear facilities.** Carpenter, A.V.; Flanders, W.D.; Frome, E.L.; Tankersley, W.G.; Fry, S.A. (Oak Ridge Associated Universities, TN (USA)). *American Journal of Industrial Medicine;* **13**: No. 3, 351-362(1988).

In a nested case-control study of workers employed between 1943 and 1977 at two nuclear facilities, we evaluated the possible association of primary CNS cancers with occupational exposure to chemicals. Seventy-two white male and 17 white female workers who, according to the information on death certificates, died of primary CNS cancers were identified as cases. For each case, four controls were matched on race, sex, facility at which initially employed (cohort), year of birth, and year of hire. Each job title/department combination was subjectively evaluated for potential exposure to each of 26 chemicals or chemical groups. Statistically significant associations were not found between CNS cancer deaths and any of the 26 chemicals. An increased risk of CNS cancer occurrence was observed among subjects employed for more than 20 yr (OR = 7.0, 95% CI = 1.2,41.1, cases = 9).

38003 **Personnel neutron-gamma and criticality accident dosimetry in perspective.** Sims, C.S.; Swaja, R.E.; Weng, P.S. (Oak Ridge National Lab., TN (USA)). *Ho Tzu K'o Hsueh;* **24**: No. 2, 113-140(Apr 1987). Contract AC05-84OR21400.

This is a review article based on several intercomparison studies and training courses on personnel dosimetry and criticality accident dosimetry held at the Oak Ridge National Laboratory. The main topics to be dealt with are (1) personnel neutron dosimetry, (2) dose equivalent estimation for neutrons, (3) neutron dosimeter calibration, (4) gamma monitoring in mixed fields, (5) dosimetry accreditation programs in the US, (6) criticality accident dosimetry, and (7) conclusions. 27 references, 6 figures, 12 tables.

38004 **Role of repair processes in neoplastic transformation induced by ionizing radiation in C3H/10T1/2 cells.** Hill, C.K.; Elkind, M.M.; Han, A. pp 379-398 of Mammalian cell transformation: Mechanisms of carcinogenesis and assays for carcinogens. Barrett, J.C.; Tennant, R.W. New York, NY; Raven Press (1985).

In this contribution the authors discuss only the elucidation of mechanisms underlying the induction and modulation of neoplastic transformation by the type and mode of radiation delivery. There is ample evidence that ionizing radiations are oncogenic, for example, the excess tumors appearing among the survivors at Hiroshima and Nagasaki. However, the processes involved in the production of tumors are still not clearly understood despite much research into the damage produced by radiation. In what follows the authors describe those features of transformation in vitro that they believe to be characteristic of the inducing agent, ionizing radiation; these features are also present in the process of tumor induction in rodents by radiation. Because the biophysics of the induction process by radiation differs in several fundamental ways from that connected with transformation induced by chemicals or viruses, radiation studies may provide insights into mechanisms that may be unique. However, for such studies, strict control and consistency must be present in the assay system to ensure reproducible results. So, first they deal with some biological factors that determine the consistency of the assay.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 37841, 37859

38005 **(DP—1739-7) Comprehensive Cooling Water Study: Volume 7, Ecology of Par Pond, Savannah River Plant: Final report.** Wilde, E.W. (ed.). (Savannah River Lab., Aiken, SC (USA)). Oct 1987. Contract AC09-76SR00001. 227p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88010407/JAW.

The Comprehensive Cooling Water Study (CCWS) was initiated in 1983 to evaluate the environmental effects of the intake and release of cooling water on the structure and function of aquatic ecosystems at the Savannah River Plant. The initial report (Gladden et al., 1985) described the results from the first year of the study. This document is the final report and concludes the program. The report comprises eight volumes. The first is a summary of environmental effects. The other seven volumes address water quality, radionuclide and heavy metal transport, wetlands, aquatic ecology, Federally endangered species, ecology of Par Pond, and waterfowl. 222 refs., 31 figs., 67 tabs.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 35692, 35782, 36648, 36652, 36995, 37657, 37728, 37743, 37746, 37759, 37816, 37826, 37858, 37868, 37977, 37988, 37994, 38004

38006 **(AD-A—189938/4/XAB) Teratogenicity, mutagenicity, and effects of Grade 2 diesel fuel on reproduction in a single generation of rats. Technical report, October 1979-July 1980.** Starke, W.C.; Pellerin, R.J.; Burnett, D.C.; Manthei, J.H.; Heitkamp, D.H. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). Oct 1987. 28p. (CRDEC-TR—87083). NTIS, PC A03/MF A01.

Pregnant dams were exposed to DF-2 smoke, of tank exhaust for 1 hr and to noise from the tank's engine for 20-30 sec. One litter in the DF-2 smoke group had three fetuses with major, gross malformations and two with visceral abnormalities. The DF-2 smoke group also showed the greatest number of fetuses with sites of low bone ossification. Males in the DLM study and the males and females in the single-generation (SG) reproduction study were exposed to DF-2 smoke or exhaust for 15 or 60 min. Unexposed dams were mated to DLM males from the 15-min exhaust group during the males' second week of post-exposure. These females had significantly more resorptions than the noise controls for the same mating period. The major malformations observed in the teratology study occurred in rather isolated instances. Retarded bone ossification was indicated in the DF-2 smoke group but without significantly lower body weights. Nothing indicates that DF-2 smoke caused fetal-growth retardation. Observances in the DLM study were not strong enough to suspect a mutational effect, and the observations in the SG study gave no support for adverse effects on reproduction.

38007 **(AD-A—190412/7/XAB) Evaluation of the acute toxicity of a synthetic polyalphaolefin-based hydraulic fluid. Technical report, June 1986-May 1987.** Kinkead, E.R.; Culpepper, B.T.; Henry, S.S.; Pollard, D.L.; Kimmel, E.C. (Northrop Services, Inc./Environmental Sciences, Dayton, OH (USA)). Nov 1987. 37p. NTIS, PC A03/MF A01.

In contingency planning for alternative hydraulic fluids in the event that critical shortages should occur in the supply of petroleum based fluids, the US Navy has investigated various synthetic compounds including polyalphaolefins. Earlier toxicity assessments (1983) on five formulations of polyalphaolefin hydraulic fluids and a base fluid indicated that one formation (N501) was toxic via inhalation. This material was reformulated (now designat-

ed B85-174) and retested along with its base polyalphaolefin (R-1061-3). The LC50 values for the reformulated hydraulic fluid B85-174 were 1.60 and 1.37 mg/L for male and female rats, respectively. Nor was the material irritating to the skin or eyes of treated rabbits. Similar results were obtained from tests on the base polyalphaolefin used for comparison. In contrast, the previous base material demonstrates con inhalation toxicity. THe 1983 and 1986 polyalphaolefin base materials were obtained form different suppliers and infrared analysis demonstrated compositional differences.

38008 **(AD-A—190413/5/XAB) Evaluation of the acute toxicity of four water-in-oil emulsion hydraulic fluids. Technical report, July 1986-April 1987.** Kinkead, E.R.; Culpepper, B.T.; Henry, S.S.; Pollard, D.L.; Kimmel, E.C. (Northrop Services, Inc./Environmental Sciences, Dayton, OH (USA)). Nov 1987. 45p. NTIS, PC A03/MF A01.

As a part of the Submarine Damage Prevention program, four commercial water-in-oil emulsion class of compounds consists of stable emulsions of micronic or submicronic water droplets suspended in a high-quality petroleum-base oil. These fluids also contain special additives to give the final product lubricity, corrosion-protection properties, emulsion stabilizers, and resistance to bacterial and fungal growth. The most significant exposure routes for hydraulic fluids are expected to be dermal, due to spills or leaks, and aerosol inhalation, from pressurized-system leaks. The studies conducted included eye and skin irritation, skin sensitization, oral and dermal toxicity, and aerosol inhalation. They also provided data to compare the short-term exposure effects of these various emulsions. None of the testbed compounds were toxic by the oral or dermal routes of administration. The viscous nature of these emulsions were limited to aerosol concentrations that could be tested. At the maximum attainable concentrations, no deaths or toxic effects were noted in the exposed animals. All of the materials were mildly irritating to the eyes but not on the skin. One of the materials testbed had a slight potential to sensitize treated animals.

38009 **(AD-A—190430/9/XAB) Effects of CW (chemical warfare)-related chemicals on social behavior and performance. Annual report, 30 September 1984-29 September 1985.** Bunnell, B.N.; Iturrian, W.B. (Georgia Univ., Athens (USA)). 1 Oct 1985. 57p. NTIS, PC A04/MF A01.

This report summarizes work accomplished in the second year of a three-year project aimed at developing a battery of tests of social behavior and performance that wil be sensitive to the effects of chemical warfare-related chemicals considered for use as antidotes or prophylactics against chemical-warfare agents. Procedures for assessing social behavior in nonhuman primates are described and compared. Performance scores on three operant schedules, a test of complex problem solving, and behavior in a novel environment are presented and correlations between the social and performance variables are examined. The effects of atropines on several of the social and performance measures are reported as are data from plasma hormone assays for cortisol and prolactin.

38010 **(AD-A—190431/7/XAB) Effects of CW (chemical warfare)-related chemicals on social behavior and performance. Annual report, 30 September 1983-29 September 1984.** Bunnell, B.N.; Iturrian, W.B. (Georgia Univ., Athens (USA)). 1 Oct 1984. 69p. NTIS, PC A04/MF A01.

This report summarizes work accomplished in the first year of a three-year project aimed at developing a battery of tests of social behavior and and performance that will be sensitive to the effects of chemical warfare-related chemicals considered for use as antidotes or prophylactics against chemical-warfare agents. Procedures for assessing social behavior in nonhuman primates are described and compared. The presence and absence of correlations between social behavior and performance on two operant schedules, a test of complex problem solving, and behavior in a novel environment are reported as are the effects of caffeine (as a control) and atropine on the social and performance variables.

38011 **(AD-A—190532/2/XAB) Comparative study regarding the association of alpha-2U globulin with the nephrotoxic mechanism of certain petroleum-based Air Force fuels. Final report, 1 September 1986-31 August 1987.** Eurell, T.E. (Illinois Univ., Urbana (USA). Dept. of Veterinary Biosciences). 27 Oct 1987. 14p. NTIS, PC A03/MF A01.

Alpha-2U globulin is a low-molecular-weight urinary protein which may be associated with a hydrocarbon-induced proximal tubular cell degeneration in the male rat kidney. A new method was developed to obtain monospecific immunologic reagents for alpha-2U globulin using diafiltration, anion exchange and hydroxylapatite chromatography. Isoelectric focusing techniques were developed to isolate the major isoelectric variants of the alpha-2U globulin molecule and to assess changes in alpha-2U globulin after experimental exposure to hydrocarbon compounds. Alpha-2U globulin was isolated from the urine of albino and pigmented male rats to study strain susceptibility to the nephrotoxic process. An alpha-2u globulin isoelectric variant profile distinguishing albino from non-albino male rats was not apparent, however, strain differences were revealed. Fischer 344 male rats appear to have higher levels of the isoelectric variants than the other strains studied. These findings suggest that if a strain susceptibility to the hydrocarbon-induced nephrotoxic lesion exists, it may be associated with the alpha-2U globulin isoelectric variant profile.

38012 **(AD-A—190750/0/XAB) Use of lanthanum to detect changes in the permeability barrier of rat skin after dermal exposure to organic chemicals.** Mattie, D.R.; McDougal, J.N.; Chase, M.R.; Hixson, C.J. (Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH (USA)). 1987. 3p. (AAMRL-TR—87-076). NTIS, PC A02/MF A01.

Pub. in Proceedings of the Annual Meeting of the Electron Microscopy Society of America (45th), 870-871(1987).

Occupational dermal exposures to organic solvents are of importance due to local effects in the skin and systematic toxicity if penetration occurs through the skin. Repeated or prolonged contact with organic solvents have been shown to penetrate the skin; little information is available however, concerning effects on the barrier properties of skin after dermal exposure to solvents. This investigation examines the ultrastructural changes in rat skin after exposure of 3 organic chemicals and to correlate changes with the location of an electron-dense tracer, lanthanum, which is normally excluded by the permeability barrier in the stratum corneum. Male rats were exposed for 24 h to sterile saline, trichloroethylene (TCE), perchloroethylene (PERC), or toluene using dermal-exposure cells developed in this laboratory. Rat skin exposed to saline for 24 h appeared normal. Rat skin exposed to neat TCE, PERC or toluene for 24 h caused acute, coagulative necrosis of the epidermis and upper 1/2 to 1/3 of the dermis.

38013 **(BFR-R—69-1986) Air quality in private dwellinghouses. A study of need related ventilation.** Loegdberg, A.; Adling, A. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 27p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752886/JAW.

The requirements laid down in the Swedish Building Code (SBN) regarding the ventilation of dwellings do not produce an acceptable air quality in bedrooms if the comfort requirements which should apply regarding relative humidity and carbon dioxide content in the room air are taken into consideration. One easy and inexpensive way in which an improvement can be brought about is to install extraction terminals in bedrooms also. A reduction in the total air change rate of the building to about 0.3 per hour which will result in a not inconsiderable saving in energy, is possible at the same time. Measurements of air change rates have been made, using both tracer gas and hot wire anemometer, in buildings equipped with extraction terminals in the bedrooms and in reference buildings of the same type. The reference buildings have a traditional ventilation system with extraction terminals in all /sup w/et/sup /rooms, clothes cupboard and kitchen. In both cases outside air is admitted into the buildings through slot valves in the window frames. The results in the investigations show that indoor climate in the bedrooms is considerably better when extraction terminals are installed in the bedrooms than when air is extracted in the traditional way. No moisture or mould problems have been found and, what is more important, the occupants consider the indoor climate to be good.

38014 (BFR-R—79-1986) Chemicals in mechanical heat pumps. Environmental aspects and health hazards. Engzell, R. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 19p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752889/JAW.

In its background description, this report describes the principles of mechanical heat pumps, data on the present market for heat pumps in Sweden, chemicals used in mechanical heat pumps and the known environmental effects and health hazards to persons working on such equipment. The report also describes handling of the chemicals before and after use in mechanical heat pumps, together with methods of tracing and measuring leakage of working media. The report indicates that there is a need for further research, and presents a proposal for a research program intended to ascertain the effects of large mechanical heat pumps on the environment. The program proposal includes suggestions for dealing with the problem of tracing and handling leakage of working media into the air, and of handling and final disposal of chlorinated fluorocarbons from mechanical heat pumps. The proposal also includes a survey of basic work already carried out on existing heat pump plants, and a comparison of them with an ideal plant, together with an assessment of the differences.

38015 (BNL—40979) Health and safety aspects of new photovoltaic cell manufacturing technologies. Fthenakis, V.M.; Moskowitz, P.D.; Hamilton, L.D. (Brookhaven National Lab., Upton, NY (USA)). Sep 1987. Contract AC02-76CH00016. 18p. (CONF-871113—7). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007551/JAW.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Production of thin-film photovoltaic cells entails extensive handling of toxic (e.g., AsH_3, PH_3, H_2Se), and flammable or explosive (e.g., SiH_4, H_2) materials. Large scale manufacture of these photovoltaic cells may present potential health and safety hazards to workers and the public. Consequently, analysis of these hazards is required before full commercialization, so that alternative strategies may be developed, safety controls may be incorporated in the initial design, control costs reduced and health risks minimized. In this paper hazards to occupational and public health related to the toxicity and explosiveness of several feedstock gases are evaluated. The largest hazards are posed by accidental gas releases from storage or process systems. The most efficient way to reduce these hazards is to prevent accident initiating events through choice of inherently safer technology and material, appropriate design and construction, and administrative options. If an accidental release happens, engineering (e.g., flow restrictors, scrubbers) and administrative (e.g., emergency response) risk reducing measures will be needed. 13 refs., 1 fig., 5 tabs.

38016 (BNL—40988) Improving health-related monitoring, data collection, and associated analysis for diseases related to environmental pollution. Morris, S.C. (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007753/JAW.

This report describes specific improvements which can be made to existing health-related monitoring, data collection and analysis to provide better information on environment-health linkages and to better support decision-making on allocation of resources and trained personnel. The improvements considered include (1) Closer coordination among monitoring of disease, health status and environmental pollution; (2) New concepts of environmental monitoring specifically oriented to population exposure rather than ambient environmental levels; (3) New concepts of exposure monitoring oriented to total environmental exposure, rather than independent estimates of exposure and effect; (5) Direct surveillance of human populations; (6) Measurement of exposure co-factors; (7) Measurement of genetic and constitutional co-factors; (8) Standardizing health and census data; (9) Coupling of socio-economic measures with environmental and health measures; (10) Collection of morbidity information on environment-related diseases not now generally reported; (11) Baseline geochemistry measurements and monitoring of body burdens of pollutants in the populations; (12) Epidemiological surveillance; (13) Coordinated occupational exposure monitoring and occupational registers; (14) Monitoring and follow-up of environmental emergencies; and (15) Improvement of modeling, analytical, and display techniques to relate population health data with environmental exposures. 22 refs.

38017 (CONF-870524—4) Serum lipid levels in neighboring communities with chlorinated and nonchlorinated drinking water. Zeighami, E.A.; Watson, A.P.; Craun, G.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011830/JAW.

From 6. conference on water chlorination: environmental impact and health effects; Oak Ridge, TN, USA (3 May 1987).

The Wisconsin Heart Health Research Program was designed to ascertain levels of serum lipids and other clinical parameters among residents of a total of forty-six neighboring small communities in central Wisconsin. The purpose of the study was to determine whether distribution of serum lipids, blood pressure or thyroid hormones differed according to the chlorination of the water supply, or to the calcium and magnesium content (hardness) of the drinking water supply. This report examines the relationship of chlorination and water calcium to estimated community mean serum lipid levels. The estimated community means are adjusted for potential confounders, including age, education level, alcohol intake, smoking, dietary fat and dietary calcium. Serum cholesterol levels proved to be significantly higher in chlorinated communities for females. Levels of serum cholesterol were also higher in chlorinated communities for males, but differences were considerably smaller and not statistically significant. Low-density lipoprotein cholesterol levels were also higher in chlorinated communities for females ($p = .06$). Levels of high-density lipoprotein (HDL) cholesterol were higher in hard water communities than in soft water communities, although the p-value for the hardness term did not quite reach significance at $p < .05$ in either model. The regression of community mean HDL levels on both drinking water calcium and magnesium levels was positive, indicating increasing mean HDL levels with increasing calcium and/or magnesium content in the drinking water.

38018 (CONF-880313—1) General theoretical approach to dose response modeling - implications for risk assessment. Walsh, P.J.; Jones, T.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012208/JAW.

From International life science symposium; Knoxville, TN, USA (20 Mar 1988).

The major point of this discussion is that it is unlikely that there exists a unique dose response relationship even for the simple case of a single toxic material in a single biological system. Different dose response relationships can be produced by varying the dose rate (which affects cellular alteration and killing rates) as related to cellular dynamics (turnover time) and repair rates. Thus, in extrapolation from high dose, high dose rate conditions, not only the magnitude of variables but also the fundamental nature of the dose response is being changed. In the general case, one must at least consider an n-dimensional dose response surface rather than a single curve presented in only 2 dimensions.

38019 (CONF-880558—8) Acute toxicity of uranium hexafluoride, uranyl fluoride and hydrogen fluoride. Just, R.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010138/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

Uranium hexafluoride (UF_6) released into the atmosphere will react rapidly with moisture in the air to form the hydrolysis products uranyl fluoride (UO_2F_2) and hydrogen fluoride (HF). Uranium compounds such as UF_6 and UO_2F_2 exhibit both chemical toxicity and radiological effects, while HF exhibits only chemical toxicity. This paper describes the development of a methodology for assessing the human health consequences of a known acute exposure to a mixture of UF_6, UO_2F_2, and HF. 4 refs., 2 figs., 5 tabs.

38020 **(DOE/ER/60151—T1) Trace metal and trace organic detoxification in marine organisms: Final report.** Jenkins, K.D. (California State Univ., Long Beach (USA). Molecular Ecology Inst.). 20 Jun 1986. Contract AC03-83ER60151. 3p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008561/JAW.

We have examined the underlying mechanisms of subcellular copper and cadmium metabolism in larvae of the mud crab, Rhithropanopeus harrisii, and the polychaete worm, Neanthes arenaceodentata. In developing crab larvae we found that Cu accumulation is precisely regulated at lower exposures. At exposures higher concentrations than those normally found in the estuary from which the organisms were collected, however, Cu regulation appears to break down and Cu accumulates on metallothionein (MT) and very low molecular weight (VLMW) ligands. Larval growth rates were found to be significantly reduced when Cu accumulation in the MT pool exceed the half saturation constant (km). Accumulation of Cu in the VLMW pool was also highly correlated with reduced larval growth.

38021 **(EPRI-EA—5820) Effects of food and water quality on culturing and toxicity testing of Ceriodaphnia dubia: Final report.** Cooney, J.D.; DeGraeve, G.M.; Moore, E.L.; Palmer, W.D.; Pollock, T.L. (Battelle Columbus Div., OH (USA)). May 1988. 193p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010640/JAW.

Effects of Food and Water Quality on Culturing and Toxicity Testing of Ceriodaphnia dubia. Tests of eight diets for culturing Ceriodaphnia have identified two foods that support high and consistent survival and reproduction. Use of these foods can contribute to the precision of EPA recommended effluent toxicity tests.

38022 **(EUR—10704-EN) Biological indicators for the assessment of human exposure to industrial chemicals.** Alessio, L.; Berlin, A.; Boni, M.; Roi, k. (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation; Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1987. 86p. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Industrial health and safety.

The original title of the first volume of the series 'Human Biological Monitoring of Industrial Chemicals Series' was changed in the second volume and this change is now further justified by the four monographs making up the third volume: alkyl lead compounds, dimethylformamide, mercury and organophosphorus pesticides. Separate abstracts were prepared for 2 chapters (alkyl lead compounds and mercury).

38023 (EUR—10704-EN, pp 3-15) **Alkyl lead compounds.** Alessio, L.; Dell'Orto, A.; Forni, A. 1987. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Industrial health and safety.

In Biological indicators for the assessment of human exposure to industrial chemicals.

The main route of absorption of alkyl lead compounds is via the respiratory tract but the skin, too, offers an excellent penetration route for both tetraethyl lead (TEL) and tetramethyl led (TEM). The toxic effects of alkyl lead compounds involve mainly the central nervous system. Only slight alterations in heme synthesis have been demonstrated, which contrasts with the situation in the case of inorganic lead. Lead in urine (PbU) is at present the only biological indicator that can be used for assessment of occupational exposure to organic lead compounds.

38024 (EUR—10704-EN, pp 29-46) **Mercury.** Foa, V.; Bertelli, G. 1987. Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

Industrial health and safety.

In Biological indicators for the assessment of human exposure to industrial chemicals.

Mercury is mainly eliminated with the urine. Determination of mercury in urine is at present the most widely used indicator of exposure; values calculated on a group basis were found to be well correlated with the environmental concentrations. However, the correlations can be established only after about one year from the beginning of exposure, when the binding sites in the kidney are saturated. It should be borne in mind that although HgU is an indicator of exposure, it does not permit evaluation of the dose in the critical organ (central nervous system). Fewer studies have been made on the behaviour of HgB. It has been found that the levels of this indicator are correlated with the levels of HgU in occupationally exposed subjects. At present no biological tests are available that can be used for evaluation of early reversible effects due to mercury. Due to the high toxicity of organic mercury compounds, especially alkyl mercurials, their use in industry has been banned in many countries. Non-occupational exposure to these compounds, via ingestion of contaminated food, does, however, occur to a considerable extent. The digestive apparatus is the most effective route of absorption and elimination occurs via the faeces. Organic mercury compounds easily cross the blood-brain barrier causing serious alterations to the central nervous system. The measurement of HgB is a useful test for evaluating the degree of exposure, but measurement of HgU is of no practical use. No indicators of early biological effect exist for alkyl mercury compounds.

38025 (INIS-mf—11233, pp 37) **Chelate-induced changes in metal disposition: studies on dithiocarbamates, pyridinethiones, xanthates and dithiophosphates in rodents and in fishes.** Tjaelve, H.; Jasim, S.; Gottofrey, J.; Borg, K. (Swedish Univ. of Agricultural Sciences, Uppsala). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702880/JAW. (CONF-8708259—).

From 2. international symposium on chelating agents in pharmacology, toxicology and therapeutics; Pilsen, Czechoslovakia (12 Aug 1987).

38026 **(Juel-Spez—413) Status seminar on the BMFT research project 'Research into the causes of forest decline'. Proceedings.** Stuettgen, E. (comp.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie). Aug 1987. 363p. (In German). (CONF-8703265—). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW.

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

During 31st March - 3rd April 1987 the 'Project Management for Biology, Ecology, Energy' in the Nuclear Research Centre Juelich organized on behalf of the Federal Ministry of Research and Technology (BMFT) a seminar concerning 'Research into the causes of forest decline'. Results of 95 projects funded by the BMFT were presented by poster presentations on the following topics: Deposition of pollutants, immission; symptoms of damage, inventory (remote sensing) wood increment, wood quality; effects on above parts of trees, physiology; soil chemistry, assessment of nutrient situation (fertilization trials); soil biology, root/soil-rhizosphere interactions; epidemiology and modelling. Research results concerning the mentioned topics as well as an evaluation of the results are reported. Separate records are available for 106 papers in this report.

38027 (Juel-Spez—413, pp 4-5) **Analysis of the interdependence between site conditions and forest decline on the basis of regional statistics - preliminary study.** Neuland, H. (Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.). Abt. Umwelt- und Regionalplanung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38028 (Juel-Spez—413, pp 6-9) **Systems analysis and simulation of the growth dynamics of forest trees in polluted sites.** Bossel, H.; Krieger, H.; Schaefer, H.; Trost, N. (Kassel Univ. (Gesamthochschule) (Germany, F.R.). Forschungsgruppe Umweltsystemanalyse). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38029 (Juel-Spez—413, pp 10-11) **Simulation of the energy and mass balance of healthy and damaged forest ecosystems for selected forest regions of the Federal Republic of Germany.** Kohlmaier, H. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Physikalische und Theoretische Chemie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38030 (Juel-Spez—413, pp 12-15) **Testing of hypotheses on forest decline using dynamic feedback models and regional balance calculations for four selected research zones of the Federal Republic of Germany.** Haber, W.; Bachhuber, R.; Grossmann, W.D.; Tobias, K.; Schaller, J. (Technische Univ. Muenchen, Freising (Germany, F.R.). Lehrstuhl fuer Landschaftsoekologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38031 (Juel-Spez—413, pp 16-17) **Time-series-orientated growth models for forecasting and statistical testing of hypotheses on systematic disturbances in pine growth, and planning of experiments for this purpose.** Sloboda, B.; Riemer. Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38032 (Juel-Spez—413, pp 18-19) **Development of a measuring method and of mathematical models for a quantitative description of ion dynamics in the rhizosphere of forest trees under natural conditions.** Beese, F. (Goettingen Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38033 (Juel-Spez—413, pp 20-24) **Report of group A: Model development.** Bossel, H.; Kohlmaier, G.H. Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38034 (Juel-Spez—413, pp 25-26) **Electron microscope investigations on the contribution of viruses, mycoplasms, rickettsia-type organisms, and fungi to the forest decline syndrome.** Heitefuss, R.; Ebrahim-Nesbat, F. (Goettingen Univ. (Germany, F.R.). Inst. fuer Pflanzenpathologie und Pflanzenschutz). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38035 (Juel-Spez—413, pp 30-31) **Investigations of the fungal flora of damaged forests.** Butin, H. (Biologische Bundesanstalt fuer Land- und Forstwirtschaft, Braunschweig (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38036 (Juel-Spez—413, pp 32-33) **Grafting experiments as a test of the epidemia hypothesis as an explanation of 'novel' forest diseases.** Braun, H.J. (Freiburg Univ. (Germany, F.R.). Inst. fuer Forstbotanik und Holzbiologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38037 (Juel-Spez—413, pp 34-36) **Investigations on viral diseases of forest ecosystems.** Nienhaus, F. (Bonn Univ. (Germany, F.R.). Inst. fuer Pflanzenkrankheiten). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38038 (Juel-Spez—413, pp 37-38) **Transfer experiments and light and electron microscope analyses for testing the contributions of procaryonta (MLO, RLO) to the new forest decline.** Petzold, H. (Biologische Bundesanstalt fuer Land- und Forstwirtschaft, Berlin (Germany, F.R.). Inst. fuer Mikrobiologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38039 (Juel-Spez—413, pp 39-40) **Investigations of the possible contribution of mycoplasma/rickettsia-type organisms and spiroplasms to forest decline.** Seemueller, E. (Biologische Bundesanstalt fuer Land- und Forstwirtschaft, Dossenheim (Germany, F.R.). Inst. fuer Pflanzenschutz im Obstbau). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38040 (Juel-Spez—413, pp 41-42) **Investigations of virus infections in affected trees in southern Germany.** Frenzel, B. (Hohenheim Univ., Stuttgart (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38041 (Juel-Spez—413, pp 43-45) **Department B: Epidemiology - summary and analysis.** Nienhaus, F. Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38042 (Juel-Spez—413, pp 57-59) **Investigation of the adsorption/transport/distribution of organic airborne pollutants through/inside leaves.** Figge, K. (Natec-Gesellschaft fuer Naturwissenschaftlich-Technische Dienste m.b.H., Hamburg (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38043 (Juel-Spez—413, pp 72-76) **Chairman's report on the immission and deposition research projects.** Jaeschke, W. (Frankfurt Univ. (Germany, F.R.). Zentrum fuer Umweltforschung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38044 (Juel-Spez—413, pp 77-79) **Morphological changes in tree shoot development and growth, in leaves dropping, in bark and roots.** Bartels, H. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forstbotanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38045 (Juel-Spez—413, pp 80-82) **Growth rates and structural development of pollution-damaged beech forests in different sites.** Kramer, H. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forsteinrichtung und Ertragskunde). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38046 (Juel-Spez—413, pp 83-85) **Large-area monitoring of changes in growth rates and tree structures in polluted forests, using aerial photography dendrometry, and tree ring analysis.** Kramer, H. Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38047 (Juel-Spez—413, pp 86-87) **Planning and evaluation of experiments in the acid rain and forest decline investigation project in the Hils area.** Sloboda, B. (Goettingen Univ. (Germany, F.R.). Abt. fuer Forstliche Biometrie und Informatik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38048 (Juel-Spez—413, pp 88-90) **Investigation of the wood characteristics of pine trees from damaged forest of different sites in North West Germany.** Knigge, W.; Hapla, F. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forstbenutzung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38049 (Juel-Spez—413, pp 91-93) **Growth analyses of healthy and damaged conifers in South West Germany (Black Forest, Alpine foothills), with particular regard to immissions.** Abetz, P. (Freiburg Univ. (Germany, F.R.). Inst. fuer Waldwachstum). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38050 (Juel-Spez—413, pp 94-95) **Histological, histochemical and enzymological in vivo and in vitro investigations of tissue samples from diseased trees.** Braun, H.J.; Fink, S. (Freiburg Univ. (Germany, F.R.). Inst. fuer Forstbotanik und Holzbiologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38051 (Juel-Spez—413, pp 96-101) **Effects of disease phenomena on forest structure and growth rates.** Franz, F.; Roehle, H. (Muenchen Univ. (Germany, F.R.). Lehrstuhl fuer Waldwachstumskunde). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38052 (Juel-Spez—413, pp 102-103) **Biological, chemical and technological properties of wood from diseased pine trees as a means of assessing the causes and effects of damage.** Bauch, J.; Fruehwald, A.; Puls, J. (Hamburg Univ. (Germany, F.R.). Ordinariat fuer Holzbiologie; Hamburg Univ. (Germany, F.R.). Ordinariat fuer Holztechnologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38053 (Juel-Spez—413, pp 104-105) **Fine structure and ultracytochemical investigations of fir and spruce exposed to SO_2, ozone, and NO/sub x/.** Liese, W.; Schmitt, U. (Bundesforschungsanstalt fuer Forst- und Holzwirtschaft, Hamburg (Germany, F.R.). Inst. fuer Holzbiologie und Holzschutz). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38054 (Juel-Spez—413, pp 106) **Investigation of the fir damage classification on the basis of total needle mass and needle quotients.** Lanz, W. (Fachhochschule Hildesheim/Holzminden, Goettingen (Germany, F.R.). Fachbereich Forstwirtschaft). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38055 (Juel-Spez—413, pp 107-108) **Remote monitoring and mapping of forest damage.** Landauer, G. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (DFVLR), Koeln (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38056 (Juel-Spez—413, pp 109-112) **Quantification of forest tree damage on the basis of spectral reflection characteristics.** Ammer, U.; Koch, F.B. (Muenchen Univ. (Germany, F.R.). Lehrstuhl fuer Landschaftstechnik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38057 (Juel-Spez—413, pp 113-114) **Interpretation of airborne scanner data as a means of assessing vitality in pine trees.** Ammer, U. (Muenchen Univ. (Germany, F.R.). Lehrstuhl fuer Landschaftstechnik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38058 (Juel-Spez—413, pp 115-116) **Diagnosis and detection of forest damage on the basis of spectral signatures (multispectral scanner data and field data).** Kenneweg, H.; Foerster, B.; Runkel, M. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Landschafts- und Freiraumplanung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38059 (Juel-Spez—413, pp 117-118) **Analyses of the methodology of large-area forest damage inventories and damage progress by remote monitoring and combined remote and field monitoring. Part project 1. Combined remote and field monitoring.** Hildebrandt, G.; Tepasse, P. (Freiburg Univ. (Germany, F.R.). Abt. fuer Luftbildmessung und Fernerkundung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38060 (Juel-Spez—413, pp 119-121) **Aalyses of the methodology of large-area forest damage inventories and damage progress by remote monitoring and combined remote and field monitoring. Pt. 2.** Kadro, A. (Freiburg Univ. (Germany, F.R.). Abt. fuer Luftbildmessung und Fernerkundung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38061 (Juel-Spez—413, pp 122) **Large-area diagnosis and monitoring of forest damage using multispectral scanner data for the Frankfurt city forest.** Schramm, M. (Institut fuer Planungsdaten in der Stadt- und Regionalforschung und Oekologie G.m.b.H., Offenbach am Main (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38062 (Juel-Spez—413, pp 124-145) **Damage symptoms, inventory (remote monitoring), wood growth rates, wood quality.** Ammer, U.; Kenneweg, H. Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38063 (Juel-Spez—413, pp 152-153) **Susceptibility to infestation with needle-biting insects of spruce from forests with different damage rates.** Schopf, R. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forstzoologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38064 (Juel-Spez—413, pp 154-156) **Effects of sulphur compounds and ozone on plant growth and development.** Schaub, H. (Frankfurt Univ. (Germany, F.R.). Botanisches Inst.). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38065 (Juel-Spez—413, pp 157) **Comparative investigations of the effects of gaseous pollutants on terpene emissions from spruce and pines in different sites and in climate chambers.** Schaub, H. (Frankfurt Univ. (Germany, F.R.). Botanisches Inst.). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38066 (Juel-Spez—413, pp 158-160) **Effects of acid rain on the barrier function of plant cuticles.** Lendzian, K.J. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Botanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38067 (Juel-Spez—413, pp 161-162) **Effects of acid fog on washout of nutrient ions and carbohydrates of young spruce and on the development of damage symptoms.** Mengel, K.; Breininger, M.T.; Lutz, H.J. (Giessen Univ. (Germany, F.R.). Inst. fuer Pflanzenernaehrung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38068 (Juel-Spez—413, pp 163-164) **Analysis of alkylated lead compounds in precipitations and leaves, and investigations of the toxic effect of triethyl lead.** Faulstich, H. (Max-Planck-Institut fuer Medizinische Forschung, Heidelberg (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38069 (Juel-Spez—413, pp 165-167) **Investigation of the effects of airborne ozone on young and older spruce and beech.** Kettrup, A. (Paderborn Univ. (Gesamthochschule) (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38070 (Juel-Spez—413, pp 168-169) **Effects of pollutants on the primary processes of photosynthesis.** Renger, G.; Graeber, P. (Technische Univ. Berlin (Germany, F.R.). Max-Volmer-Institut fuer Biophysikalische und Physikalische Chemie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38071 (Juel-Spez—413, pp 170-171) **Investigations of pollution damage in the Frankfurt city forest with particular regard to car engine emissions. Effects of air pollution under the aspects of ecology and vegetation science.** Gies, T.; Braun, H.; Kuechler, A. v. (Frankfurt Univ. (Germany, F.R.). Zentrum fuer Umweltforschung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38072 (Juel-Spez—413, pp 172-173) **CO_2 and H_2O gas change by beech trees in the Solling hills as an indicator of latent pollution effects.** Runge, M. (Goettingen Univ. (Germany, F.R.). Lehrstuhl fuer Geobotanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38073 (Juel-Spez—413, pp 174-176) **Carbon, nutrient and water metabolism of young spruce forests in the Fichtelgebirge mountains.** Schulze, E.D.; Oren, R.; Zimmermann, R.; Meyer, J.; Werk, K.S. (Bayreuth Univ. (Germany, F.R.). Lehrstuhl Pflanzenoekologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38074 (Juel-Spez—413, pp 177-179) **Early detection of air pollution damage in trees on the basis of volatile hydrocarbon emissions.** Rennenberg, H. (Koeln Univ. (Germany, F.R.). Botanisches Inst.). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38075 (Juel-Spez—413, pp 180) **Spring sap analyses in damaged and healthy trees.** Eschrich, W. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forstbotanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38076 (Juel-Spez—413, pp 181-182) **Health status of beech trees: Is it a function of natural seasonal slug discharge?.** Essiamah, S.; Eschrich, W.; Fromm, J.; Schneider, E. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forstbotanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38077 (Juel-Spez—413, pp 183-184) **Comparative gas change measurements on diseased trees in pure air and natural site air for a quantitative determination of primary damage.** Koch, W. (Muenchen Univ. (Germany, F.R.). Lehrstuhl fuer Forstbotanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38078 (Juel-Spez—413, pp 185-187) **Analysis of immission effects in selected substances in, and on, coniferes.** Schulten, H.R.; Rump, H.H. (Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38079 (Juel-Spez—413, pp 188-189) **Combined effects of SO_2 and ozone on the assimilation apparatus of spruce and fir of different constitution. A contribution to the discussion of the immission hypothesis.** Gross, K. (Freiburg Univ. (Germany, F.R.). Waldbau-Institut). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38080 (Juel-Spez—413, pp 190-191) **Terpene concentrations and emissions of needles with different pollution levels.** Ziegler, H. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Botanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38081 (Juel-Spez—413, pp 192-193) **Measurement of physiological data as a means of assessing the damaging effect of site-specific, organic and inorganic airborne substances on trees in a given site.** Doerffling, K. (Hamburg Univ. (Germany, F.R.). Inst. fuer Allgemeine Botanik und Botanischer Garten). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38082 (Juel-Spez—413, pp 194-195) **Investigation of photosynthesis damage in forests using in-vivo chlorophyll fluorescence.** Ernst, V. (Hannover Univ. (Germany, F.R.). Inst. fuer Biophysik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38083 (Juel-Spez—413, pp 196-197) **Electron microscope investigations of the accumulation and effects of airborne organic pollutants in leaves.** Kristen, U. (Hamburg Univ. (Germany, F.R.). Inst. fuer Allgemeine Botanik und Botanischer Garten). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38084 (Juel-Spez—413, pp 198-199) **Chlorosis phenomena resulting from a lack of nutrients or iron, partly induced by heavy metals; methods of measuring the light dependence and extent of chlorosis phenomena.** Schlote, F.W.; Tuecks, M.T.; Rayermann, M.; Langenbach, B.; Hiller, B.; Buhren, D. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Biologie 2 (Zoologie)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38085 (Juel-Spez—413, pp 200-201) **Photosynthesis and ion status as stress parameters in Fagus sylvatica.** Huettermann, A. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forstbotanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38086 (Juel-Spez—413, pp 202-229) **Summary and validation of results: Surface induction, pathway, physiological aspects of stress and metabolism.** Prinz, B.; Schaub, H. Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38087 (Juel-Spez—413, pp 230-232) **Biochemical analysis of soil and of the root and leaf physiology as indicators of pollution in forest ecosystems.** Huettermann, A. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forstbotanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38088 (Juel-Spez—413, pp 233-236) **Heavy metal accumulation, aluminium release, and delayed forest litter decomposition in the soil below older beech exposed to water running from the tree trunk; vegetation effects.** Glavac, V. (Kassel Univ. (Gesamthochschule) (Germany, F.R.). Arbeitsgruppe fuer Pflanzen-, Vegetations- und Landschaftsoekologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38089 (Juel-Spez—413, pp 237) **Water, nutrient and pollutant dynamics of characteristic soils of Schleswig-Holstein. Summary.** Blume, H.P.; Lamp, J. (Kiel Univ. (Germany, F.R.). Inst. fuer Pflanzenernaehrung und Bodenkunde). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38090 (Juel-Spez—413, pp 238) **Water, nutrient and pollutant dynamics of characteristic soils of Schleswig-Holstein. Validation of results.** Blume, H.P.; Lamp, J. (Kiel Univ. (Germany, F.R.). Inst. fuer Pflanzenernaehrung und Bodenkunde). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38091 (Juel-Spez—413, pp 239-242) **Effects of acid precipitations on damaged and undamaged forest ecosystems; tests of forestry measures for tree protection.** Evers, F.H. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.)). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38092 (Juel-Spez—413, pp 243-246) **Type, concentrations and function of buffer systems in soils: a. in surface horizons, b. in mineral soil.** Naetscher, L.; Suesser, P.; Schwertmann, U. (Technische Univ. Muenchen, Freising (Germany, F.R.). Lehrstuhl fuer Bodenkunde). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38093 (Juel-Spez—413, pp 247) **Type, concentrations and function of buffer systems in soils of the Fichtelgebirge.** Naetscher, L.; Suesser, P.; Schwertmann, U. (Technische Univ. Muenchen, Freising (Germany, F.R.). Lehrstuhl fuer Bodenkunde). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38094 (Juel-Spez—413, pp 248-251) **Sulphur concentrations and types of binding in southern German forest soils as a function of atmogenic sulphur deposition.** Rehfuess, K.E.; Fischer, M. (Muenchen Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38095 (Juel-Spez—413, pp 252-253) **Mobilisation, complexing, and translocation of Al and heavy metal ions in forest soil under the influence of atmogenic acidification.** Kreutzer, K.; Schierl, R. (Muenchen Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38096 (Juel-Spez—413, pp 254-258) **Water, nutrient, and pollutant dynamics of polluted granite, phyllite, slate and basalt soils in higher altitudes in North Eastern Bavaria.** Horn, R.; Zech, W. (Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde und Bodengeographie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38097 (Juel-Spez—413, pp 259) **Testing of suitable fertilizers (especially Mg, lime, and Ca) to counteract nutrient depletion induced by forest damage.** Sturm, H.; Buchner, A.; Isermann, K. (BASF A.G., Limburgerhof (Germany, F.R.). Landwirtschaftliche Versuchsstation). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38098 (Juel-Spez—413, pp 260-262) **S, N, and heavy metal transfer between ecosystem components, distribution in ecosystem compartments, and (in)direct effects on organisms.** Schlichting, E. (Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Bodenkunde und Standortslehre; Tuebingen Univ. (Germany, F.R.). Inst. fuer Geologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38099 (Juel-Spez—413, pp 263-266) **Diagnostic fertilisation experiments in immission-damaged forest ecosystems.** Zoettl, H.W.; Huettl, R. (Freiburg Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrungslehre). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38100 (Juel-Spez—413, pp 267-268) **Effects of the ion status of leaves and needles on their stress physiology.** Beese, F.; Waraghai, A.; Woehler, I. (Goettingen Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38101 (Juel-Spez—413, pp 269-275) **Development in space and time of chemical parameters of soil and roots in acid sites of the Hils mountains.** Raben, G.H.; Ulrich, B. (Goettingen Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38102 (Juel-Spez—413, pp 276) **Space/time patterns of chemical stress indicators in different forest soils.** Ulrich, B. (Goettingen Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38103 (Juel-Spez—413, pp 277-278) **Rates of deposition, accumulation and discharge of toxic airborne pollutants as a measure of pollution and pollution resistance of forest ecosystems.** Ulrich, B. (Goettingen Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38104 (Juel-Spez—413, pp 279-305) **Introduction to, and outline of, part F: Soil chemistry, nutrient metabolism (including amelioration measures).** Rehfuess, K.E.; Ulrich, B. (Muenchen Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38105 (Juel-Spez—413, pp 306-307) **Root analyses in polluted beech forests.** Roehrig, E. Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38106 (Juel-Spez—413, pp 308-309) **Dynamics and chemical composition of the fine roots of forest trees as a measure of the damage of forest ecosystems from toxic airborne pollutants.** Roehrig, E. Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38107 (Juel-Spez—413, pp 310-311) **Investigations of morphological changes on functional affections of forest tree mycorrhiza as a result of soil and air pollution.** Oberwinkler, F. (Tuebingen Univ. (Germany, F.R.). Lehrstuhl fuer Spezielle Botanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38108 (Juel-Spez—413, pp 312-313) **Root growth, nutrient uptake and pH in the rhizosphere of spruce trees.** Marschner, H. (Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Pflanzenernaehrung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38109 (Juel-Spez—413, pp 314-315) **Nutrient and water uptake and pH variations along intact long roots of spruce trees.** Marschner, H. (Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Pflanzenernaehrung). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38110 (Juel-Spez—413, pp 316-318) **Interdependences between damage of the fine roots system, including the mycorrhiza, and the incidence of new types of forest damage.** Schoenbeck, F.; Mayer, R. (Hannover Univ. (Germany, F.R.). Inst. fuer Pflanzenkrankheiten und Pflanzenschutz). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38111 (Juel-Spez—413, pp 319-320) **Effects of acid rain and lime additions on the incidence, anatomy and morphology of mycorrhiza.** Agerer, R. (Muenchen Univ. (Germany, F.R.). Inst. fuer Systematische Botanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38112 (Juel-Spez—413, pp 321-322) **Characterisation and identification of beech mycorrhiza as a basis for root analysis in the context of forest decline.** Agerer, R. (Muenchen Univ. (Germany, F.R.). Inst. fuer Systematische Botanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38113 (Juel-Spez—413, pp 323-324) **Cellular determination of the concentrations of different elements in the fine roots of healthy and damaged spruce.** Bauch, J. (Hamburg Univ. (Germany, F.R.). Ordinariat fuer Holzbiologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38114 (Juel-Spez—413, pp 325-327) **Fine roots and humus micromorphology in spruce forests with different damage levels.** Babel, U. (Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Bodenkunde und Standortslehre). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38115 (Juel-Spez—413, pp 328-329) **Assessment of changes in soil vegetation and in the chemical condition of top soils as a result of airborne pollution through the last few decades.** Jahn, G. (Goettingen Univ. (Germany, F.R.). Inst. fuer Waldbau). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38116 (Juel-Spez—413, pp 330-331) **Effects of acid and lime on the mesofauna of forest soils in the laboratory and in natural sites.** Pa Huang; Winter, K. (Niedersaechsische Forstliche Versuchsanstalt, Goettingen (Germany, F.R.). Abt. Waldschutz). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38117 (Juel-Spez—413, pp 332-333) **Exposure and resistance of litter-decomposing organisms to airborne pollutants - status analysis of bioindicator organisms in forest ecosystems.** Schauermann, J. (Goettingen Univ. (Germany, F.R.). Inst. fuer Zoomorphologie und Oekologie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38118 (Juel-Spez—413, pp 334-335) **Contribution of natural plant association to the acidification of forest soils.** Latzko, E. (Muenster Univ. (Germany, F.R.). Botanisches Inst. und Botanischer Garten). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38119 (Juel-Spez—413, pp 336-340) **Effects of acid precipitation on soil-living organisms.** Wolters, V.; Scheu, S. (Goettingen Univ. (Germany, F.R.). Zoologisches Inst.). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38120 (Juel-Spez—413, pp 341) **Toxic effects of Al and heavy metals on root growth of forest trees.** Mayer, R.; Glavac, V. (Kassel Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 13 - Stadtplanung, Landschaftsplanung; Kassel Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 19 - Biologie, Chemie). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38121 (Juel-Spez—413, pp 342-348) **Summary and evaluation of the subjects 'Mycorrhiza/rhizosphere'.** Kottke, I. (Tuebingen Univ. (Germany, F.R.). Lehrstuhl fuer Spezielle Botanik). Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38122 (Juel-Spez—413, pp 349-350) **Roots - soil - rhizosphere. Summary and evaluation.** Marschner, H. Aug 1987. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753372/JAW. (CONF-8703265—).

From Status seminar on a BMFT research project: research into the causes of forest decline; Juelich, F.R. Germany (30 Mar 1987).

38123 **(ORAU—88/B-63) Research participation programs at the National Center for Toxicological Research: FY1987 Annual report.** (Oak Ridge Associated Universities, Inc., TN (USA)). Feb 1988. Contract AC05-76OR00033. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009039/JAW.

In 1985, after negotiations spanning several years, an interagency agreement between the US Food and Drug Administration(FDA) and the US Department of Energy (DOE) established the Oak Ridge Associated Universities (ORAU) Postgraduate Research Program at the National Center for Toxicological Research (NCTR). The program was designed as a pilot program to serve as a model for anticipated future academic outreach programs for NCTR and FDA. During 1987 modifications to the

original agreement extended the program to allow participation by college and university students and faculty. The postgraduate, faculty, and student components of the program are summarized in this report. The program is administered by ORAU, a management and operating contractor for DOE.

38124 **(PB—88-185103/XAB) Absence of symptoms with carboxyhemoglobin levels of 16-23%.** Benignus, V.A.; Kafer, E.R.; Muller, K.E.; Case, M.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 6p. (EPA—600/J-87/298). NTIS, PC A02/MF A01.

Pub. in Neurotoxicology and Teratology, Vol. 9, 345-348(1987).

It has been generally accepted that carboxyhemoglobin levels between 10-20% produce mild headaches, dizziness and/or nausea. Experimental double blind exposures of 18 healthy, nonsmoking young men at rest to 7,000 - 24,000 ppm, designed to elevate COHb to 15-20% in 3-5 minutes, were followed by exposure to 232 ppm CO designed to maintain COHb level for a total of 130 minutes. Resulting COHb values were 16-23%. These COHb values did not produce significantly more symptoms than reported in the control group (n=23). The symptoms which were previously reported in clinical studies of CO poisoning may have resulted from CO exposure in combination with (a) exposure to other substances, (b) stress due to the event that precipitated medical attention or (c) higher COHb levels before the first blood sample was taken.

38125 **(PB—88-185111/XAB) Respiratory responses of subjects with allergic rhinitis to ozone exposure and their relationship to nonspecific airway reactivity.** McDonnell, W.F.; Horstman, D.H.; Abdul-Salaam, S.; Raggio, L.J.; Green, J.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 14p. (EPA—600/J-87/297). NTIS, PC A03/MF A01.

Pub. in Toxicology and Industrial Health, Vol. 3, No. 4, 507-517(1987).

Ozone exposure in man produces changes in respiratory function and symptoms. There is a large degree of unexplained intersubject variability in the magnitude of these responses. There is concern that individuals with chronic respiratory diseases may also be more responsive to ozone than normal individuals. The purpose of this study was to describe the responses of subjects with allergic rhinitis to ozone exposure and to compare these responses to those previously observed in normal individuals. A further purpose was to measure the association between baseline nonspecific airway reactivity and changes in lung function and respiratory symptoms following ozone exposure.

38126 **(PB—88-185160/XAB) Ammonia effects on microinvertebrates and fish in outdoor experimental streams.** Hermanutz, R.O.; Hedtke, S.F.; Arthur, J.W.; Andrew, R.W.; Allen, K.N. (Environmental Protection Agency, Monticello, MN (USA). Environmental Research Lab.). 1987. 37p. (EPA—600/J-87/291). NTIS, PC A03/MF A01.

Pub. in Environmental Pollution 47, 249-283(Nov 1987).

Laboratory data on ammonia effects, the US EPA national-water-quality criteria for ammonia, and ammonia site-specific criteria were evaluated in four outdoor experimental streams (one control and three treatment streams) over a 76-week period. Calculated un-ionized ammonia concentrations varied daily and seasonally according to pH and temperature changes. Populations of four major microinvertebrate taxonomic groups (cladocerans, copepods, rotifers and protozoans) were monitored during a 4-week period early in the study, and six fish species (fathead minnows, bluegills, channel catfish, white suckers, walleyes, and rainbow trout) were tested for various time intervals, from 4 to 26 weeks, throughout the 76-week study period.

38127 **(PB—88-185178/XAB) Effects of daily ozone exposure duration and concentration fluctuation on yield of tobacco.** Heagle, A.S.; Heck, W.W.; Lesser, V.M.; Rawlings, J.O. (North Carolina State Univ., Raleigh (USA)). 1987. 9p. NTIS, PC A02/MF A01.

Pub. in American Phytopathological Society, Vol. 77, No. 6, 856-862(1987).

Flue-cured tobacco (Nicotiana tabacum McNair 944) was exposed to chronic doses of ozone (O_3) in open-top field chambers to determine the influence of frequency and magnitude of peak O_3 concentrations and daily exposure duration on tobacco yield response. The treatments were established by adding O_3 in amounts that were proportional to ambient O_3 concentrations or in constant amounts. The frequency of occurrence and level of peak O_3 concentrations were greater for each proportional-addition treatment than for the corresponding constant-addition treatments. However, the seasonal mean O_3 concentrations were nearly identical, and the yield response to O_3 was similar for both types of O_3 for 12 hr/day (1000 to 2200 hours EDT) was 10% less (three treatment levels combined) than in those receiving proportional addition for 7 hr/day (1000 to 1700 hours EDT). If other important crop species have a similar response to O_3 late in the afternoon, previous national crop loss estimates based on seasonal 7 hr/day O_3 exposures may be low.

38128 **(PB—88-186788/XAB) Accumulation and retention of No. 2 fuel-oil compounds in the blue crab, Callinectes sapidus' rathbun.** Melzian, B.D.; Lake, J. (Environmental Protection Agency, Narragansett, RI (USA)). 1987. 35p. (EPA—600/J-87/304). NTIS, PC A03/MF A01.

Pub. in Oil and Chemical Pollution 3, No. 5, 367-399(1986/87).

In order to determine if Blue Crabs (Callinectes sapidus) can bioaccumulate and retain complex mixtures of petroleum hydrocarbons, adult crabs were exposed for 14 days or 30-35 days in continuous flow-through seawater systems to three sublethal concentrations, nominally 0.00 (control), 0.01, or 1.0 ppm (mg/liter), of the water-accomodated fraction (WAF) of Number (No.) 2 fuel oil. Crabs exposed for 14 days were subsequently exposed to clean running seawater for a 30 day depuration period. Gill, hepatopancreas, and muscle tissue samples were collected from control, WAF exposed, and depurated crabs and analyzed by gas chromatography and/or gas chomatography-mass spectrometry. No. 2 fuel-oil compounds were not detected in any of the tissues of the control crabs. Trace amounts of fuel-oil compounds were detected in gill and hepatopancreas tissues collected from crabs exposed to the 0.01 ppm WAF and no fuel-oil compounds were detected in muscle tissues. All tissues of crabs exposed to the 1.0 ppm WAF accumulated No. 2 fuel-oil compounds and considerable amounts remained in hepatopancreas and gill tissues following depuration for 30 days in clean seawater.

38129 **(PB—88-193081/XAB) Lead hazards to fish, wildlife, and invertebrates: a synoptic review.** Eisler, R. (Patuxent Wildlife Research Center, Laurel, MD (USA)). Apr 1988. 146p. (BIOLOGICAL—85(1.14)). NTIS, PC A07/MF A01.

Ecological and toxicological aspects of lead (Pb) in the environment are briefly reviewed, with emphasis on fish and wildlife, their predators, and prey. Subtopics include sources and uses, chemical properties, mode of action, background concentrations, lethal and sublethal effects, and current recommendations for the protection of sensitive living resources. Resources that are at increased risk from Pb include migratory waterfowl that congregate at heavily hunted staging areas and ingest shot, avian predators that consume hunter-wounded game, domestic livestock near smelters and Pb battery recycling plants, zoo animals and livestock held in enclosures coated with Pb-based paints, wildlife that forage near heavily traveled roads, and aquatic life near mining activities.

38130 **(PB—88-863972/XAB) Shellfish: toxicology studies. October 1982-May 1988 (Citations from the NTIS data base). Report for October 1982-May 1988.** (National Technical Information Service, Springfield, VA (USA)). May 1988. 61p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the effects of toxic substances on shellfish. Petroleum products, solvents, sewage, copper, mercury, chromium, dredged materials, and organic chemicals are among the toxic substances studied. Reproductive impairement, molting behavior, and population reduction caused by toxic chemicals are discussed. Shellfish as bioindicators and shellfish tolerance to toxic substances are briefly considered. Shellfish farming and economics are covered in a separate bibliography. (Contains 108 citations fully indexed and including a title list.)

38131 (PNL—6545) Dominant lethal study in CD-1 mice following inhalation exposure to 1,3-butadiene: Final technical report. Hackett, P.L.; Mast, T.J.; Brown, M.G.; Clark, M.L.; Evanoff, J.J.; Rowe, S.E.; McClanahan, B.J.; Buschbom, R.L.; Decker, J.R.; Rommereim, R.L.; Westerberg, R.B. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 85p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010185/JAW.

The effects of whole-body inhalation exposures to 1,3-butadiene on the reproductive system was evaluated. The results of dominant lethality in CD-1 male mice that were exposed to 1,3-butadiene are described. Subsequent to exposure, males were mated with two unexposed females. Mating was continued for 8 weeks with replacement of two females each week. Gravid uteri were removed, and the total number, position and status of implantations were determined. The mice were weighed prior to exposure and at 0, 1, 2, 3, 4, 5, 6, 7, and 8 weeks after exposure and at sacrifice. The animals were observed for mortality, morbidity and signs of toxicity throughout the study. 19 refs., 5 figs., 9 tabs.

38132 (SNV—3166) Toxic effects of metals on fish. Evaluation of physiological test methods. Larsson, Aa.; Haux, C.; Sjoebeck, M.L. (National Swedish Environmental Protection Board, Solna). 1986. 68p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752945/JAW.

Physiological methods, previously used as health indicators in laboratory investigations on fish exposed to environmental pollutants, have been applied to feral fish living in metal-polluted coastal waters and lakes. This report summarizes the most important results and experiences of the field and laboratory investigations. The results show that clinical physiological methods may be very sensitive instruments for detecting and diagnosing sublethal disturbances in fish living in metal-polluted waters. However, the investigations also points to possible pitfalls and many problems of crucial importance for evaluation of the test results. Aberrant values for several physiological parameters in fish indicate that metal pollution has a profound influence on important physiological functions, such as immune defense, ion regulation and glucose homeostasis. Good agreement was found between effects noted in fish exposed to metals under natural field conditions and those found in laboratory tests. In the report is also given a proposal for test strategy and selection of suitable physiological test parameters for future health investigations on fish in metal-polluted coastal waters and lakes. (authors).

38133 (UBA-FB—85-076) Uptake of cadmium in plants on various soils. Final report. Kuntze, H.; Foerster, C. (Umweltbundesamt, Berlin (Germany, F.R.); Niedersaechsisches Landesamt fuer Bodenforschung, Hannover (Germany, F.R.)). Sep 1986. 70p. (In German). Umweltbundesamt, Berlin (Germany, F.R.).

Umweltbundesamt - Texte.; No. 29/86.

In a pot-trial the influence of pH-value, N- and K-fertilization, soil-moisture, content of humus and iron of different soils was investigated. Different extractants should be tested, whether they represent the available Cd-content of the soils. Decreasing pH-value of the soils effected very much increased Cd-uptake of the plants. Liming decreased the Cd-availability. In some cases the Cd-concentration of the plants increased after high liming. Increasing K-fertilization decreased the Cd-content of some vegetables. After increasing N-fertilization the plant Cd-concentration increased, but parly caused by reduced plant-growth. On a humic sandy soil rich in Fe the Cd-concentration of the plants was much lower than that of the plants from humic sandy soils poor in Fe. Increasing addition of Fe with high solubility to a Cd-contenting soil caused yield depression, phosphate deficiency and increased Cd-content of the plants. Increasing addition of Fe with low solubility causes partly increasing yield and decreased Cd-contents. Among the 4 tested extractant 0,1 M $CaCl_2$ represented best the available Cd-content of the test soils. With 26 refs., 13 tabs., 13 figs..

38134 (UBA-FB—86-034) Phytotoxic effects of air pollutants, early identification, and its application to bioindication. Bornkamm, R.; Seeliger, T.; Schreyer, B.; Langner, S.; Koch, P.; Bussler, W.; Fischer, E.; Stan, H.J.; Wichmann, A. (Umweltbundesamt, Berlin (Germany, F.R.); Technische Univ. Berlin (Germany, F.R.)). Mar 1986. 193p. (In German). Umweltbundesamt, Berlin (Germany, F.R.).

Several crops and wildflowers were treated with natural air, filtered air and with different (realistic) ozone concentrations as well. The following parameters were investigated mainly: formation of stress ethylene; changes of cell and tissue structures detectable in light or electron microscope; diffusion resistance of leaves; growth and formation of necroses. The results show species specific differences in the sensitivity against ozone; the results were discussed under the following viewpoints: dose-effect-relation, early identification, standardization, representativeness, and diagnosis of symptoms. With 113 refs., 55 tabs., 72 figs.

38135 (UCRL—21001-88-1) Comparison of the response of mature branches and seedlings of Pinus ponderosa to atmospheric pollution: Progress report. Houpis, J.L.J.; Surano, K.A.; Cowles, S. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011315/JAW.

This report is divided into four sections. These sections are: (1) Project Overview; (2) Physiology-Morphology-Autonomy Studies; (3) Instrumentation; and (4) Data Management and Analysis. The Project Overview section contains general information relating to the management of the project. In the Physiology-Morphology-Autonomy Studies section, information and results pertaining to studies conducted in these areas are reported. The Instrumentation section includes informatiopn on topics pertaining to the branch exposure system and on instruments involved in fumigation and monitoring. The Data Management and Analysis section contains information relating to experimental design and data management.

38136 Ranking the potential carcinogenic hazards to workers from exposures to chemicals that are tumorigenic in rodents. Gold, L.S.; Backman, G.M.; Hooper, N.K.; Peto, R. (Lawrence Berkeley Lab., CA (USA)). *Environmental Health Perspectives;* **76**: 211-219(Dec 1987). Contract AC03-76SF00098.

For 41 chemicals there exist both reasonable data on carcinogenic potency in experimental animals and also a defined Permissible Exposure Level (PEL), which is the upper limit of legally permissible chronic occupational exposure for US workers. These 41 agents are ranked by an index that compares the permitted chronic human exposure to the chronic dose rate that induces tumors in 50% of laboratory animals. This index, the Permitted Exposure/Rodent Potency index, or PERP, does not estimate absolute risks directly, but rather suggests the relative hazards that such substances may pose. The PERP values for these 41 substances differ by more than 100,000-fold from each other. The PERP does not take into account the actual level of exposure or the number of exposed workers. Nevertheless, it might be reasonable to give priority attention to the reduction of allowable worker exposures to substances that appear most hazardous by this index and that some workers may be exposed to full-time near the PEL. Ranked by PERP, these chemicals are: ethylene dibromide, ethylene dichloride, 1,3-butadiene, tetrachloroethylene, propylene oxide, chloroform, formaldehyde, methylene chloride, dioxane, and benzene.

38137 The food chain as a source of toxic chemical exposure. Travis, C.C.; Arms, A.D. (Office of Risk Analysis, Health and Safety Research Div., Oak Ridge National Lab. (US)). pp 95-113 of Toxic chemicals, health and the environment. Lave, L.B.; Upton, A.C. Baltimore, MD; John Hopkins University Press (1987).

The authors are concerned with the properties of chemicals that lead to their uptake by plants and animals and to their eventual incorporation into the food supply. Some chemicals, such as DDT, become concentrated in the food chain. DDT also accumulates in the body, as does lead and other chemicals. Still other chemicals are biologically inactive and remain in the environment. The au-

thors focus on pesticides and develop a formula to predict how readily particular pesticides find their way into food.

38138 **Concentration and temporal response of tracheal organ cultures to single and repeated benzo(a)pyrene exposures.** Placke, M.; Chang, M.J.; Fisher, G.L. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH 43201 (US)). pp 755-770 of Polynuclear aromatic hydrocarbons: Chemistry, characterization and carcinogenesis. Cooke, M.; Dennis, A.J. Columbus, OH: Battelle Press (1986). (CONF-8410225—).

From 9. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (30 Oct 1984).

Comparative species studies of the metabolism, incidence, latency and type of tumor to evolve following polynuclear aromatic hydrocarbon (PAH) administration have indicated that the hamster responds in a fashion similar to the clinical and pathologic features with longterm carcinogen exposure in humans. This study assessed the occurrence and histopathologic appearance of preneoplastic alterations in the mucosa of hamster tracheal organ cultures and compared them to those reported for rat and human tissues. Explants were singly or repeatedly exposed to a range of concentrations of benzo(a)pyrene (BaP). A spectrum of changes (focal hyperplasia, multifocal anaplastic proliferations and diffuse cytotoxic damage) developed. Lesion severity was correlated with increasing concentrations. It was concluded that hamster tracheal organ cultures are more sensitive to the carcinogenic effects of BaP than the reported response from rat explants.

38139 **Recommendations for screening for potential human germ cell mutagens: An ICPEMC working paper.** Bridges, B.A.; Mendelsohn, M.L. (MRC Cell Mutation Unit, Univ. of Sussex, Falmer, Brighton, Sussex BN1 9RR (GB)). pp 51-66 of Genetic toxicology of environmental chemicals. Part B: Genetic effects and applied mutagenesis. Ramel, C.; Lambert, B.; Magnusson, J. New York, NY; Alan R. Liss Inc. (1986). (CONF-8506137—).

From 4. international conference on environmental mutagens; Stockholm, Sweden (24 Jun 1985).

If resources and feasibility permit, the rodent dominant lethal test has a clear superiority as a screening test for the detection of agents capable of causing chromosomal aberrations in male germ cells, both on rational grounds, and on the basis of its performance in the limited statistical analysis that has been possible. It possesses an additional advantage that it may also pick up some of the effects of aberrant segregation of chromosomes (aneuploidy) and some gene mutations. There is little to choose between the other three tests in terms of performance; all appear to give results at variance with the consensus assignment about 20-25 per cent of the time and therefore cannot be considered to be surrogates for a mammalian germ cell assay. A corrected accuracy of 75 to 80 per cent is considerably better than not testing at all. The tests will pick up most of the known germ cell mutagens; moreover the false results generally point the finger at substances of known or suspected carcinogenicity so that the results are not without value in overall safety evaluation. Because it is an in vivo test, does not require experienced cytogenetic skills, and is relatively cheap, the micronucleus test may prove to be marginally the more attractive of the three.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 36153, 36611, 37929, 38014

38140 **(AD-A—190118/0/XAB) Microwave dispersion and absorption in tissues: molecular mechanisms. Final report, 1 January 1978-28 February 1986.** Foster, K.R. (Pennsylvania Univ., Philadelphia (USA). Dept. of Bioengineering). 10 Dec 1987. 13p. NTIS, PC A03/MF A01.

The authors measured the dielectric properties of materials (tissues, aqueous protein solutions, microemulsions, macroscopic suspensions) from 0.1-18 GHz. These properties are determined over this frequency range by the dielectric properties of water and by ionic effects. Analysis of the data shows that the dielectric properties of the suspending water differ from those of the pure liquid, presumably due to interfacial effects. Similar effects are seen in diverse transport properties and even in nonaqueous systems. The results suggest that water within a couple of monolayers from surfaces have motional correlation times that are tenfold or so longer than those of the bulk liquid. The authors suggest that this motional restriction is a physical effect due to the presence of relatively immobile surfaces, rather than from chemically specific binding. This study has led to an improved understanding of the mechanisms of absorption of microwave energy in tissues, and shown the usefulness of comparative studies of transport processes in complex suspensions.

38141 **(AD-A—190377/2/XAB) Expedient methods for rattle-proofing certain housing components. Final report.** Schomer, P.D.; Hottman, S.D.; Kessler, F.M.; Kessler, R.K. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Dec 1987. 54p. (CERL-TR-N—87/24). NTIS, PC A04/MF A01.

Occupants of buildings located in areas of high-level impulse noise usually report that the main annoyance factor is the rattle produced by house components upon vibration. This type of noise is associated with helicopter flybys and blast overpressure from artillery and other military training operations. Methods are needed for mitigating rattles in both existing structures and future construction. This report analyzes several different elements to identify individual components contributing to rattle. Elements studied include windows, doors, wall-mounted objects, bric-a-brac, ductwork, gutters, and light fixtures, among others. In general, the primary source of rattle is any small gap between two hard surfaces that are subject to vibration from an exterior noise source. Upon excitation, these surfaces can impact each other, producing the sound. Other rattle sources are identified, and methods are recommended for eliminating or reducing noise from the individual elements.

38142 **(IVO-A—04/87) Physiological effects of extremely low frequency electric and magnetic fields.** Valjus, J. (Imatran Voima Oy, Helsinki (Finland)). 1987. 159p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752814/JAW.

According to literature, ELF electric and magnetic fields can affect several physiological systems. However, there are no undisputable evidence of adverse effects on one's health even in fields far exceeding the electric field strengths and magnetic flux densities existing in practice. From epidemiological studies there is some evidence available on the connection of magnetic field exposure and cancer. This connection is, however, so weak that it is very difficult to point it out among the many other environmental factors. In laboratory tests magnetic field has been found to affect the development of chick embryos. In mammals such effects are far more uncertain. In general, magnetic field is considered a greater risk factor than electric field. Strong electric fields may, nevertheless, cause symptoms to patients with cardiac pacemakers, and e.g. spark discharges which may cause chromosome exchanges with, at least in principle, adverse health effects. The adverse health effects of electric and magnetic fields can only be detected in large test groups. Still, the hazards to the environmental and the labour welfare by these fields are worth of studying as a part of the purity and safety image of electrical energy. Such research would also give a good basis for public information, attitudes for government policy and also for practical measures, if required.

38143 **(LBL—20812) Assessment of biological effects associated with magnetic fields from a superconducting magnetic energy storage plant: Final report.** Tenforde, T.S. (Lawrence Berkeley Lab., CA (USA)). Apr 1986. Contract AC03-76SF00098. 89p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88008412/JAW.

This report provides a detailed evaluation of the potential biological effects of fringe magnetic fields associated with a superconducting magnetic energy storage (SMES) plant. The aspects of magnetic fields that are discussed include mechanisms of interaction of static and slowly time-varying magnetic fields with living systems; biological effects of magnetic fields on human and subhuman species, including the results of both laboratory studies and human epidemiological surveys; physical hazards posed by the interactions of magnetic fields with metallic implants, e.g., aneurysm clips and prostheses, and with medical electronic devices such as cardiac

pacemakers; extant guidelines for occupational exposure to magnetic fields are summarized; recommendations for defining acceptable levels of exposure to SMES magnetic fields by occupational personnel and the population-at-large; and recommendations concerning several areas of research that would further our understanding of magnetic field interactions with living systems, and would provide additional elements of information required for the development of future exposure standards. 328 refs., 12 figs., 5 tabs.

38144 **(ORNL/TM—10769) Examination of specifications and standards relating to the susceptibility of medical electronic devices to transient electrical overstress: Task 2.** Googe, J.M.; Hess, R.A.; Ewing, P.D.; Agouridis, D.C. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 75p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010743/JAW.

This study was undertaken to address the US Army's concern for the safe operation of the Harry Diamond Laboratories (HDL) electromagnetic pulse (EMP) simulation facilities, which in turn led to concern for the safety of medical electronics equipment in general and medical electronic device wearers in particular. The main concerns of this study are the standards and regulations that address the susceptibility of these types of electronic devices to transient electrical overstress. The study revealed no standards, regulations, or industry-wide guidelines that deal with the susceptibility of medical electronics to EMI from radiative sources. The standards sought in this task do not exist, nor have any reached the stage of development to be accessible in the literature. Furthermore, the agencies that usually publish such standards have none ready for release at this time. In the course of this study it was found that the process of forming a community of interested professionals is under way but has not advanced to the point where it can provide acceptable industry standards and regulations. 28 refs.

38145 **(ORNL/TM—10784) Bioelectromagnetic effects of EMP: preliminary findings.** Aldrich, T.E.; Easterly, C.E.; Gailey, P.C.; Hamilton, C.B. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Health, Leisure and Safety; EC Corp., Knoxville, TN (USA)). Jun 1988. Contract AC05-84OR21400. 120p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88012118/JAW.

Facilities to simulate electromagnetic pulses (EMPs) are used to test military equipment and electrical communications devices for resistance to the effects of an EMP caused by an upper-atmospheric nuclear detonation. The rapid rise time and high field strengths (0.1-50 kV/m) of an EMP distinguish it from other electromagnetic phenomena. Certain types of EMP simulators also expose facility operators and members of the public to electromagnetic fields of varying intensity as do other natural sources such as the fields produced near a lightning bolt. Limited biological effects data have been collected to assess the potential EMP health hazards to humans. Evidence from the available database does not establish that EMPs represent either an occupational or a public health hazard. A critique is presented of the EMP research published to date in order to explore its limitations and similarities with related outcome experience from other electromagnetic field research. Laboratory research and multiple years of observations on workers in existing EMP manufacturing and simulation facilities suggest that there are no acute or short-term health effects. The occupational exposure guideline for EMP is 100 kV/m, which is far in excess of usual exposures with EMP simulators. There are many persistent questions surrounding biological effects of electromagnetic fields. Based on these concerns, research needs are identified for determining to what extent biological systems exposed to EMPs reflect phenomena currently being observed with other electromagnetic exposure regimens. Additional options relate to continuing medical surveillance of occupationally exposed personnel and studies of communities proximal to EMP simulators.

38146 **Reduction of the nocturnal rise in pineal melatonin levels in rats exposed to 60-Hz electric fields in utero and for 23 days after birth.** Reiter, R.J.; Anderson, L.E.; Buschbom, R.L.; Wilson, B.W. (Univ. of Texas Health Science Center, San Antonio (USA)). *Life Sciences;* **42**: No. 22, 2203-2206(1988). Contract AC06-76RL01830.

Rats exposed to 60-Hz electric fields of either 10, 65, or 130 kV/m from conception to 23 days of age exhibited reduced peak nighttime pineal melatonin contents compared to unexposed controls. As a group, the exposed rats also exhibited a phase delay, estimated at approximately 1.4 hours, in the occurrence of the nocturnal melatonin peak. No clear dose-response relationship was noticed over the range of electric field strengths used as treatments in these experiments. These are the first studies concerned with the effects of electric field exposure on the pineal melatonin rhythm in immature rats. The findings are generally consistent with those obtained using adult rats, where electric field exposure has been shown to abolish the nighttime rhythm in pineal melatonin concentrations.

38147 **Effects of electric lighting on human muscle strength: Visible spectrum and low frequency electromagnetic radiation.** Jewett, D.L.; Berman, S.M.; Greenberg, M.R. (Dept. of Orthopaedic Surgery, Univ. of California, San Francisco, CA 94143 (US)). pp 390-391 of The medical and biological effects of light. Wurtman, R.J.; Baum, M.J.; Potts, J.T. New York, NY; The New York Academy of Sciences (1985). (CONF-8410211—).

From New York Academy of Science conference on medical and biological effects of light; New York, NY, USA (31 Oct 1984).

Ten subjects who stated that they were bothered by fluorescent lighting were studied using maximal strength of shoulder forward flexion. Fifty trials, each a randomized sequence of paired exposures to 400 foot-candle incandescent and cool-white fluorescent light, were measured in each subject in order to counterbalance effects of fatigue. Over all subjects, the mean difference in maximal muscle strength for the two lighting conditions was less than 0.2% of the usual strength measured. The results of Study I are not in agreement with the popular writings of John Ott, who used "kinesiology testing" to support his claims that muscle weakness was caused by both cool-white fluorescent light and lack of electric field shielding. Mr. Ott agreed to test the effect of shielding, double-blind, using his kinesiological evaluation of the subjects' strength. The authors conclude that blinding the kinesiology testing significantly alters the results, which in the unblinded case is susceptible to suggestion, and any claims based upon use of this methodology, unblinded, are suspect.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 39043

38148 **(NP—8770210) Higher safety on the job as a result of object formation and behaviour control. Psychological aspects of industrial safety in everyday situations.** Schroeder, O.E. (Verein Deutscher Ingenieure (VDI), Duesseldorf (Germany, F.R.). Fachgruppe Textil und Bekleidung). 1986. 44p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770210/JAW.

The study outlines the development of the systems 'man/environment' and 'man/technology' and the human patterns of action. The findings on human patterns of action are then applied to the working environment, especially to objects and behaviour. Standards and habits are named as basic elements of safety at work. Particular interest is taken in the criteria required for the formation of patterns of behaviour, learning processes for acquiring 'safe' habits, and the application of the latter in the field of industrial health. The role of groups as carriers and formers of habits is stressed, and improvisation at work is briefly mentioned. (HSCH).

38149 **(UCRL—97975) Temperature profiles in forced-ventilation enclosure fires.** Backovsky, J.; Foote, K.L.; Alvares, N.J. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 11p. (CONF-880634—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006807/JAW.

From 2. international symposium on fire safety science; Tokyo, Japan (13 Jun 1988).

We investigated the effect of ventilation rate, ventilation configuration, fire elevation, and the presence of a plenum (suspended ceiling) on the fire compartment temperatures during forced ventilated methane gas fires (100-400 kW). We found that with low air-inlet positions, fires with ventilation rates greater than

2 to 3 times the stoichiometrically required air (referred to here as well-ventilated fires) produce two-layer temperature profiles; fires with a lower ventilation rate (under-ventilated fires) produce single-layer profiles with a temperature gradient. Higher temperatures throughout the enclosure are seen in underventilated fires as compared to well-ventilated fires. We observed that high air-inlet locations perturb the two-layer temperature profile of the well-ventilated fire, cooling the upper layer and heating the lower layer. For underventilated fires, high air-inlet locations lower temperatures in the enclosure but do not perturb the profile shape. Elevated fires and fires in a compartment with a plenum were seen to behave similarly for the same distance from fire base to ceiling, producing hotter layers the shorter the distance. 9 refs., 13 figs.

38150 **Methodology for the selection of environmental dispersion models in health-risk assessments.** Seiler, F.A. (Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). *Environment International;* 13: No. 4-5, 351-357(1987). Contract AC04-76EV01013.

Criteria for the selection of environmental dispersion models in health risk assessments are analyzed. The state of knowledge on the health effect exerts a dominant influence on this evaluation, which focuses on averaging procedures, the resolution in space and time, and error propagation. Uncertainties in the cause-effect relationship are the final contributions to the error of the result. Intermediate calculations should neither increase this error unduly nor be carried out with an accuracy significantly better than that which can be achieved in estimating the health effects. In this context, a methodology for performing credible calculations with an effort commensurate with the state of knowledge is discussed. 21 references, 1 figures, 1 table.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 35619, 35793, 35796, 35867, 36078, 37004, 37007, 37009, 37227, 37272, 37792, 37793

38151 **(CONF-880582—2) Scaling of hydrologic properties for simulation of watershed drainage.** Wilson, G.V.; Luxmoore, R.J.; Jardine, P.M.; Jones, J.R. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010458/JAW.

From Validation of flow and transport models for the unsaturated zone meeting; Ruidoso, NM, USA (23 May 1988).

Facilities suitable for field testing of transport models involving continuous monitoring of hillslope drainage have been developed in a 0.45-ha forested subwatershed in eastern Tennessee. The soil properties, K(θ) and θ({psi}), estimated in situ for each horizon of one reference pedon have been determined. The hydraulic properties of the site have been intensively characterized and scaling factors determined from surface infiltration and subsurface permeameter measurements. The results of semivariogram analyses indicate that surface and subsurface properties are random processes. The dynamics of subsurface flow in this forested watershed during storm events are being monitored, and results from a selected high intensity rainfall event of 51.4 mm are outlined. 16 refs., 6 figs., 2 tabs.

38152 **(CRIE-U—86047) Investigation on water quality and isotopic composition of ground water in bedrock. Study on ground water dating (3).** Motojima, Isao. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 24p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88752548/JAW.

The age and maturation of ground water in a bedrock were studied by the water quality and isotopic composition. The object was the ground water discharged in the work tunnel for ground cavern (about 450m depth) located in North Kanto area. The chemical composition of ground water was predominantly composed of the dissolved rock composition and newer and more fluid ground water was intermixed easily around the investigated site. ^{222}Rn concentration was different in each location of discharged water owing to the difference of intermixed water quantity of comparatively newer ground water and the difference of saturation degree in the permeated ground water. Tritium concentration were different in all discharged locations but the degree was lower compared with ^{222}Rn. The origin of underground water at the investigated time (1985) was concluded to be rainfall in 1967 and the rate of more aged ground water was 10 to 20% by the study of half life of tritium and law of mass conservation, indicating that the rate of comparatively newer ground water was much more. (7 figs, 5 tabs, 5 refs)

38153 **(INIS-BR—1094) Geological interpretation of aeromagnetics and aeroradiometrics data of Carajas area - sheet SB-22-Z-A-III.** Marinho, F.A.V.; Azevedo, M.L.V. de. (Companhia de Pesquisas de Recursos Minerais, Rio de Janeiro (Brazil)). 1986. 13p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702791/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

The upward continued map of sheet SB.22-Z-A-III in the Carajas Mineral Province shows the magnetic anomalies associated to the Leste Ridge, Carajas fault and Rabo Ridge to be more complex than apparent from the total magnetic field map. It also shows that the Carajas granite truncates metasediments of the Salobo Sequence northeast of the Carajas fault. First vertical derivative processing with reduction to the pole has been effective in the definition of the magnetic structures associated with the upper crustal sequences of the basement complex of the Carajas area and has made it possible the definition of the magnetic lineations associated with the tectonic structure of the area. The apparent magnetic susceptibility map has further reinforced the interpretted zones and the structures that were defined from the first vertical derivative map. The radiometric data were important in the definition of the granite borders and in the separation of the Salobo and Grao-Para units. This work suggest improvements to the geologic knowledge of this part of the Carajas area. Based on this geophysical interpretation and correlation with known mineralizations, priority areas have been identified as having high potential for economic mineralization. Recommendations are made for more detailed geophysical follow-up studies in these areas.

38154 **(INIS-BR—1106) Geocronology study of the power sequence of the Sao Roque group.** Schmus, W.R. van; Tassinari, C.C.G.; Cordani, U.G. (Kansas Univ., Lawrence (USA). Dept. of Geology). 1986. 8p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702801/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

U-Pb results on zircons, as well as Rb-Sr whole rock analyses, were carried out on metarhyodacites of the Sao Roque Group, located on the Morro do Povilho, near Santana do Parnaiba (SP). These rocks are interbedded with E-W trending metapelites which underlie meta-arkoses and metaconglomerates of the lower sequence of the Sao Roque Group. In a Concordia plot, the U-Pb zircon analytical points were aligned in a chord with an upper intercept of 1790 +- 14 Ma., which shall be interpreted as the zircon crystallization age. The lower intercept, of about 500 Ma., is referred to an important lead loss episode in late Proterozoic times, which is confirmed by the Rb-Sr whole rock analyses. The age values on the Sao Roque Group can be correlated with similar values obtained on acid volcanics of the Espinhaco Supergroup in Minas Gerais and Bahia, and they strongly suggest that the lower metassedimentary units of the group could be much older than the upper sequences.

38155 **(INIS-mf—11199) Radiometric dating by alpha spectrometry on uranium series nuclides.** Wijk, A. van der. (Rijksuniversiteit Groningen (Netherlands)). 6 Nov 1987. 167p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702376/JAW.

Contains summary in Dutch and previously published material.

This thesis describes the analytical and technical procedures that are required for routine application of both the ^{230}Th^{234}U dis-

equilibrium dating method for peat and the ^{210}Pb dating method for lake sediments. Its principal aim is to test, refine and discuss the reliability and validity of these methods. On the other hand, the analytical procedures that were introduced open a wide range of other interesting fields of research that are not necessarily restricted to geological problems only. Chapter 5 reports an obviously not foreseen application: detection of alpha emitting nuclides released in the first weeks of May, 1986 during the accident with the nuclear power plant in Chernobyl, USSR. 128 refs.; 43 figs.; 15 tabs.

38156 **(LBL—24453) A scheme for calculating flow in fractures using numerical grid generation in three-dimensional domains of complex shapes.** Muralidhar, K.; Long, J.C.S. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 143p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE88008426/JAW.

A numerical scheme for the solution of fluid flow equations in a complex three-dimensional geometry has been developed in order to study fluid flow in rock fractures. The scheme consists of two parts, the first being a grid generator and the second, a flow solver in a generalized coordinate system. The grid is determined by mapping the irregular flow region of the fracture, onto that bounded by a rectangular parallelepiped. The mapping function is implicitly defined via differential equations, which in turn are derived from a variational principle. This procedure is general enough to incorporate various aspects of grid control such as orthogonality, mesh concentration, treatment of singular points etc. However, only orthogonality has been included in this report. The others are not expected to be significant in the problem of fluid flow in a single fracture. Complete details of the derivation of the governing equations and boundary conditions have been given here. The flow is taken to satisfy the Navier-Strokes equations. These are also solved numerically, by simultaneously solving for the pressure field from a Poisson equation. The complete procedure is validated by computing various test cases, which have been included in this report.

38157 (NAGRA-NTB—87-15, pp 335-343) **Formation of migmatites in metapelite rocks from boreholes of Northern Switzerland: preliminary results.** Mazurek, M. (Basel Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

High-grade metapelites from two boreholes in northwest Switzerland comprise a wide spectrum of minerals and textures. Three metamorphic stages may be distinguished: 1) amphibolite facies metamorphism and deformation, 2) generation of migmatites, 3) retrogressive overprint. The metamorphic P-T path in terms of quantitative phase diagrams is compared with microtextural evidence. The different leucosome patterns and geometries yield constraints on the processes leading to migmatization. Anatexis and metamorphic differentiation appear to be the most likely mechanisms. Evidence for the existence of metamorphic segregations in a certain rock type of the borehole of Leuggern is shown. As a conclusion, it is suggested that both anatexis and metamorphic segregation contributed to migmatization. (author) 20 refs., 5 figs., 1 tab.

38158 (NAGRA-NTB—87-15, pp 345-367) **Facies analysis and depositional environments of the Permocarbon in the trough of Northern Switzerland.** Matter, A. (Bern Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

A narrow, 10-12 km wide, late Variscan trough with a clastic fill of Stephanian to Upper Rotliegend age has recently been discovered in northern Switzerland through the geophysical investigations and deep boreholes drilled by Nagra. Sedimentological facies analysis of the continuously cored sequences from the wells Kaisten, Riniken and Weiach enables the depositional environments and the sedimentary evolution of this trough to be reconstructed. A 572 m thick Upper Carboniferous sequence was recorded from Weiach and comprises six cyclical units. Of these, three units are characterized by large scale fining upward cycles ('Grosszyklische Series'), the middle one of which is coal-bearing. Each of these megacyclical units is interbedded and alternates with small scale fining upward cycles ('Kleinzyklische Series'). The megacycles reach up to 38 m in thickness. These consist of a sandstone member, comprising stacked first-order fining upward cycles, and an argillaceous member, comprising laminated siltstone rhythmites and varvelike, bituminous dark grey mudstones. The 'Kleinzyklische Series' are characterized by the presence of cm- to dm-bedded sheet-like sandstones interbedded with siltstones, mudstones thin coals and tuffaceous ash beds. They are readily distinguished from the 'Megazyklische Series' by a sandstone/shale ratio of <2. Erosional sharp basal contacts, lag deposits, dune and ripple cross-bedding and a fining upward grain size profile identify these megacycles as fluvial deposits. The considerable thickness of their sandstone members indicates rapid vertical aggradation and channel stability. This as well as the type of sedimentary structures and the fact that the sandy channel deposits are enclosed in argillaceous sequences ('Kleinzyklische Series') suggest an anastomosing river system. 31 refs., 9 figs.

38159 (NAGRA-NTB—87-15, pp 369-381) **Diagenesis of Permian alluvial fan deposits of Northern Switzerland.** Bluem, W. (Bern Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Fine-grained sandstones of Permian alluvial fan deposits from three Nagra boreholes (Weiach, Riniken, Kaisten) and an exploration well, drilled at Wintersingen are clast supported, moderately sorted arkosic greywackes containing typically 2-20 % clayey matrix. Petrographic studies indicate that the origin of this clayey matrix is postdepositional. Mechanical infiltration of fines and diagenetic reddening of detrital and authigenic iron oxides are the earliest recorded events. Additionally, nodular calcites of calcrete origin and fibrous illitic clays are also ascribed to the eogenetic environment. The present strong compaction fabric results from general lack of eogenetic framework supporting cements. During mesogenesis, secondary porosity was generated through partial removal of early calcite. At the same time, a first generation of syntaxial quartz cementation and a subsequent fibrous illite authigenesis took place. Leaching of detrital K-feldspars post-dating compaction is recorded throughout the studied boreholes. The following burial diagenetic events differ between the various boreholes: in Weiach and Wintersingen kaolinite, illite, prismatic quartz and ankerite/siderite are recorded; in Riniken K-feldspar, illite, prismatic quartz and dolomite developed; whilst in Kaisten K-feldspar and microcrystalline quartz-cement dominate. These differences reflect the chemistry, pH and ionic strength of the pore fluids. Filling of veins by dolomite/ankerite, iron-rich and subsequent iron-poor calcite is the latest recorded event. (author) 21 refs., 10 figs., 1 tab.

38160 (NAGRA-NTB—87-15, pp 397-413) **Diagenesis of Triassic evaporites in Northern Switzerland.** Dronkert, H. (Bern Univ. (Switzerland)). 1987. Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Examination of Triassic cores from the Nagra boreholes Schafisheim, Riniken, Leuggern, Boettstein and Weiach and the NOK well Beznau, reveal a complex sequence of evaporitic authigenic minerals, including dolomite, gypsum, anhydrite, halite, chert and talc, which are interpreted to represent an eogenetic assemblage. Subsequently, during mesogenetic (burial) diagenesis gypsum dehydrated to anhydrite. Later replacement of anhydrite by megaquartz and dolomite is recorded in sulphate-bearing carbonate beds. Concentrations of sphalerite, fluorite and megaquartz are also present throughout the studied sequence. Ultimately, following post-Tertiary uplift, meteoric water ingress into the shallow wells Beznau, Boettstein and Leuggern resulted in telogenetic hydration of the anhydrite, causing fracturing of the host rock and extensive dissolution of the sulphates. Although most original sedimentary structures are still preserved, practically all the primary authigenic minerals have undergone subsequent diagenetic modification since eogenesis. (author) 57 refs., 27 figs.

38161 (NAGRA-NTB—87-15, pp 415-430) **Lithostratigraphy and correlation of the Dogger sediments in the boreholes of Weiach, Riniken and Schafisheim.** Blaesi, H.R. (Bern Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Middle Jurassic sediments (the 'Dogger Group' of Switzerland) in three Nagra boreholes (Weiach, Riniken and Schafisheim) are correlated on the basis of facies relationships with the equivalent sediments at outcrop in the Jura mountains of canton Aargau (Switzerland) and southern Germany. In Weiach, the Dogger Group is dominated by mudrocks and forms a typical basinal sequence known locally as the 'Schwaebische facies'. By contrast, in Schafisheim the sequence is very similar to the outcrop in the Aargau Jura mountains and is represented by carbonate sediments forming a typical platform facies. The Dogger Group sediments at Riniken lie in an intermediate position and comprise an interfingering of platform and basinal facies. In all three boreholes a series of shallowing-upward regressive cycles can be recognized in the Dogger Group sediments. These cycles are correlated with worldwide sea level changes. The culmination of the shallowing-upward sequences is usually marked by the occurrence of iron-rich oolites formed during periods of low sedimentation rate either at the end of a regressive phase or during rapid sea level rise at the beginning of the subsequent transgression. (author) 34 refs., 5 figs., 1 tab.

38162 (NAGRA-NTB—87-15, pp 431-447) **Biostratigraphy of the upper Toarcian and of the Toarcian/Aalenian boundary in the boreholes of Weiach, Beznau, Riniken and Schafisheim (Northern Switzerland).** Troester, J. (Tuebingen Univ. (Germany, F.R.)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Microfossils, mainly ostracodes, allow to subdivide the upper Toarcian from Aalenian strata in four wells from Northern Switzerland. (author) 9 refs., 11 figs.

38163 (NAGRA-NTB—87-15, pp 449-459) **Micropaleontological investigation at the Callovian/Oxfordian boundary in the Swiss Jura and the Swabian Alb (preliminary communication).** Huber, B.; Mueller, B.; Luterbacher, H. (Tuebingen Univ. (Germany, F.R.)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

The Callovian/Oxfordian boundary (athleta- to transversarium zone) was examined with foraminifera, ostracodes and dinoflagellates in sections from the Swabian Alb and the Swiss Jura mountains controlled as accurately as possible by ammonites. In this study, no useful stratigraphical markers were found among the foraminifera. The successive occurrence of three forms from the Nophrecythere cruciata-group (ostracodes) is of particular significance. The samples contain a rich dinoflagellate flora (47 genera, 80 species), but a direct application of published dinoflagellate zonations is not possible. (author) 18 refs., 16 figs.

38164 (NAGRA-NTB—87-15, pp 543-552) **Fossil maturity, Paleothermogradients and strata gap in the borehole of Weiach in the light of model calculations of thermal maturity.** Kempter, E.H.K. (Rico Research, Petroleum Geologists, Niederrohrdorf (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Thermal maturities, observed on core samples from Nagra's borehole Weiach, are abnormally high. The vitrinite reflectances measured have nothing to do with present temperature conditions. They reflect fossil maturity acquired probably already during the Permian. A preliminary study on behalf of Nagra, involving computer modelling of the thermal history of Weiach, suggests an average thermogradient of about 104 degrees C/km, effective until the end of the Early Permian. This value is more than twice as high as the present one. The most probable thermal model, which leads to calculated equivalents of vitrinite reflectance in close agreement with observed values, requires a stratigraphic gap of about 1000 m somewhere between the base of the Buntsandstein and the top of the Lacustrine Interval (Lower Autunien). The gap would also represent a significant thermal unconformity, separating rocks subjected to strongly contrasting thermal regimes. The algal organic material, identified in samples from the Early Autunian lacustrine deposits, exhibits a range of maturity values normally regarded as typical for the oil generating zone. Likewise, vitrinite reflectances measured on samples of the Stephanian coal, are typical for the zone of gas/condensate generation. However, hydrocarbon shows reported while drilling were insignificant. The paradox may be explained by hydrocarbon generation having taken place a long time ago, allowing some 250 million years to the hydrocarbons to escape particularly during repeated episodes of faulting, uplift and erosion. Most may have been lost at the end of the Paleozoic already. (author) 9 refs., 2 figs.

38165 (NAGRA-NTB—87-15, pp 569-578) **New insights into properties of the ground waters of Northern Switzerland.** Schmassmann, H. (Geologisches Buero Dr. H. Schmassmann, Liestal (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Since 1981, Nagra has conducted extensive regional studies into the hydrophysical and hydrochemical properties of deep groundwaters from northern Switzerland and adjacent areas. The understanding of the groundwaters in the Triassic and Permian aquifers as well as in the crystalline basement has been considerably enhanced by the deep drilling program of Nagra. This paper presents selected results of the investigations and discusses them with respect to deep groundwater flow systems in northern Switzerland. The composition of dissolved gases present in the groundwaters is very characteristic for each of the different aquifers. Oxygen is almost invariably absent and nitrogen is often the dominant gas. High nitrogen-argon-ratios, as typical of the Permian and Lower Triassic aquifers indicate that a part of the nitrogen is released from organic compounds. In the vicinity of the Rhine graben, ascending carbon dioxide results in a high concentration of this gas in the deep groundwaters of the crystalline basement. Radiogenic-produced helium is enriched in these waters due to the long subsurface retention times. South of the Jura mountains, high concentrations of hydrogen sulphide in waters of the Upper Muschelkalk aquifer are related to the occurrence of hydrocarbons. The Malm, Upper Muschelkalk and Permian-Lower Triassic aquifers and locally that of the crystalline basement are all separated by hydraulic barriers as demonstrated, for example, by the Weiach borehole. Waters of each of the different aquifers can be clearly distinguished from their hydrogeochemistry. The NaCl-character of the Malm aquifer water is attributed to marine formation waters that descended from the overlying Molasse sediments. Comparatively low mineralisation in the waters of the Upper Muschelkalk suggests that there is a significantly high flow rate in this aquifer. 3 refs., 3 figs., 5 tabs.

38166 **(NAGRA-NTB—87-15) Contributions to the geology of Northern Switzerland.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). 1987. vp. (In German). (CONF-8610398—). Nagra, CH-5401 Baden.

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Items within the scope of EDB have been entered individually into the data base. (ACR)

38167 **(USGS/MAP/I—1767) Geologic map of the quaternary and tertiary deposits of the Big Dune quadrangle, Nye County, Nevada, and Inyo County, California.** Swadley, W.C.; Carr, W.J. (Geological Survey, Denver, CO (USA)). 1987. Contract AI08-78ET44802. 20p. NTIS, PC A03;3. Order Number DE88010834/JAW.

38168 **(USGS-OFR—87-617) Late Cenozoic evolution of the upper Amargosa River drainage system, southwestern Great Basin, Nevada and California.** Huber, N.K. (Geological Survey, Menlo Park, CA (USA)). 1988. Contract AI08-78ET44802. 26p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010306/JAW.

A major part of the upper Amargosa River drainage system is centered on Timber Mountain, a high central area within a volcanic caldera northeast of Beatty, Nevada, on the west margin of the Nevada Test Site. The basic drainage pattern in this area was established soon after caldera collapse and resurgent dome formation about 11 million years ago. The gross drainage pattern has changed little since then, although subsequent volcanic activity has temporarily blocked drainage channels. As there have been no significant changes in subbasin geometry, general tectonic stability of the region during this time is implied. A major change in alluvial regimen occurred with the end of major alluvial-fan construction within the drainage system and the beginning of fanhead erosion that formed incised washes. The size and shape of incised channels differ, but they show a similar relation to the geomorphic parameters of their respective drainage basins—including such diverse-appearing washes as the deep Fortymile Wash and the wide, shallow wash on the Amargosa River downstream from Beatty. If the subbasin drainages have not changed appreciably during the Quaternary, then the forcing mechanism for the change in alluvial regimen is most likely either climatic or tectonic. Because this change appears to have occurred at about the same time throughout the upper Amargosa River drainage system, a climatic cause is preferred; its nature and timing are still speculative, but probably was increasing aridity that reached a threshold in the middle Pleistocene. This analysis also concludes that a postulated Pleistocene drainage capture by the Fortymile Canyon drainage system did not occur and that a large Pliocene lake in the Amargosa Desert, the postulated "Lake Amargosa", is equivocal.

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REFER ALSO TO CITATION(S) 36989, 37623

38169 **(DOE/ER/13628—T1) Shallow-crustal magma zones in and south of Long Valley, California: Final report for the period 1 Sept 1986 to 30 April 1988.** Peppin, W.A. (Mackay School of Mines, Reno, NV (USA). Seismological Lab.). 25 Apr 1988. Contract FG08-86ER13628. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009214/JAW.

This report summarizes our investigations of seismic data from the Long Valley caldera region based mainly on data obtained from the USGS-Doe seismic network. During the period several thousands of earthquakes were recorded and located, including the extensive aftershock sequence of the July 1986 Chalfant Valley. This contract has provided partial operating support for this network, including the establishment of the first permanently-recording wideband digital station in the Mammoth Lakes region. Results presented here unclude five manuscripts involving various aspects of the research. These manuscripts cover: (1) a general description of unusual seismic phase near Mammoth Lakes and their possible use in the delineation of shallow-crustal anomalous bodies, (2) a paper which pinpoints the location of a shallow-crustal anomaly about 6 km deep and 2 to 3 km in lateral near the south end of Hilton Creek fault, (3) the documentation of a strong lateral structural change in the vicinity of Inyo Craters, and (4) papers contributing to knowledge of the tectonics of the Mammoth Lakes area.

38170 **(DOE/ET/44802—T22) Aeromagnetic map of Nevada: Caliente sheet.** Saltus, R.W.; Snyder, D.B. (Nevada Bureau of Mines and Geology, Reno (USA); Nevada Univ., Reno (USA). Mackay School of Mines; Nevada Univ., Reno (USA)). 1986. Contract AI08-78ET44802. 13p. NTIS, PC A03;3. Order Number DE88008625/JAW.

Two maps are presented, one at 1:250,000 displaying the residual magnetic field for four separate surveys, and one at 1:1,000,000 adjusting the datums to a common elevation and merging the surveys. (ACR).

38171 **(DOE/RL/70039—10) Earthquake monitoring of eastern and southern Washington: Annual technical report 1985.** (Washington Univ., Seattle (USA). Dept. of Geophysics). Sep 1985. Contract AS06-75RL70039. 79p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010541/JAW.

This report covers the operations and research performed on the seismicity and structure of eastern and southern Washington and northern Oregon for the year, July 1, 1984 to June 30, 1985.

38172 **(DOE/RL/70039—11) Earthquake monitoring of eastern Washington: Annual technical report 1986 [July 1, 1985-June 30, 1986].** (Washington Univ., Seattle (USA)). Oct 1986. Contract AS06-75RL70039. 52p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010540/JAW.

This report covers the operations and research performed for DOE by the University of Washington Geophysics Program on the seismicity and structure of eastern Washington and northeastern Oregon for the year, July 1, 1985 to June 30, 1986. There are presently 111 stations in Washington and northeastern Oregon whose data are telemetered to the University for recording, analysis and interpretation. Section I covers the operation of the network including station maintenance, data processing and telemetry problems in eastern Washington and the Washington-Oregon border area. A fairly detailed description of the switch to BPA microwave telemetry is included. The seismicity of the past year and a description of the catalog is covered in Section II. Section III is a description of our experiments with an earthquake location routine for eastern Washington using a velocity structure including a low-velocity zone. Section IV gives the detailed results of our re-calibration of the USGS amplitude magnitude scale used between 1969 and 1974 for magnitude determinations in eastern Washington. Section V is an exploration of techniques to improve timing accuracy and relative locations are studied using a well recorded swarm of earthquakes in the Cascades. The appendix includes the catalog of earthquakes located in eastern Washington during this year and a table of station outages.

38173 **(DOE/RL/70039—12) Earthquake monitoring of eastern Washington: Annual technical report, 1987.** Malone, S. (ed.). (Washington Univ., Seattle (USA). Dept. of Geophysics). Oct 1987. Contract AS06-75RL70039. 80p. NTIS, PC A05;3. Order Number DE88010539/JAW.

This report covers operations and research on the seismicity and structure of eastern Washington and northeastern Oregon for the year, July 1, 1986 to June 30, 1987. The report covers the operation of the regional seismograph network including station maintenance and calibration, data processing and operational problems. A detailed description of the current network including telemetry routing through the BPA microwave system is included. This section also details a new VCO system developed to improve the center-frequency stability and reliability of our field stations. The seismicity of the past year and a description of the catalog is covered.

38174 **(LBL—21814) Inversion of static displacement of the earth's surface.** Vasco, D.W. (Lawrence Berkeley Lab., CA (USA)). Aug 1986. Contract AC03-76SF00098. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88011886/JAW.

A method is presented which uses observations of surface displacement to place constraints on the components of the strain tensor at depth. Using a volume integral form of Volterra's integral and a series expansion method, the problem is discretized. An extremal inverse approach is described allowing the calculation of bounds on model parameters from bounds on the data. Methods of placing bounds on generalized moments of the perturbing body are developed, and techniques of handling errors in the data are discussed. A special case, the use of uplift measurements to bound fractional volume change in the subsurface, is developed. The connection between extremal bound techniques and the method of ideal bodies is explored. As an application, uplift data from 1982, 1983 and 1985, are used to constrain the depth and horizontal extent of any possible magma intrusion at depth. It was found that, in order to satisfy the 1982, 1983 and 1985 uplift data, volume ex-

pansion was required above depths of 11, 9 and 8 kilometers respectively. Furthermore, bounds on fractional volume change of individual blocks were calculated. Finally, a method is developed which determines multiple solutions to non-linear inverse problems. An extension of Newton's method for non-linear optimization, the algorithm projects through solutions and searches for additional ones. The technique is applied to finding best fitting polyhedral volume source for a given displacement anomaly. This method has applications in many areas of geophysics.

38175 **(LBL—24928) A code to compute borehole fluid conductivity profiles with multiple feed points.** Hale, F.V.; Tsang, C.F. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 54p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008401/JAW.

Investigators wish to determine the flow characteristics of fractures intersecting a wellbore to understand the hydrologic behavior of fractured rocks. Often inflow from these fractures into the wellbore is at very low rates. A new procedure has been proposed and a corresponding method of analysis developed to obtain fracture inflow parameters from a time sequence of electric conductivity logs of the borehole fluid. The present report gives the details of equations and computer code used to compute borehole fluid conductivity distributions. Verification of the code used and a listing of the code are also given. 9 refs., 5 figs., 7 tabs.

38176 (NAGRA-NTB—87-15, pp 287-303) **Tectonic evolution of Northern Switzerland.** Laubscher, H. (Basel Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

The tectonic evolution of Northern Switzerland is characterized by a superposition of events, with the preceding ones strongly influencing their successors. The oldest, stratigraphically documented one is the late Paleozoic trough of Constance-Frick. It was recently discovered on reflection lines and in drill holes. Seismic evidence suggests a dextrally-transpressive belt with occasional transtensive episodes and rapidly varying depths, reaching down to 7 km. This picture fits into the frame of a broad dextral transform belt between the Appalachians and the Urals which has been postulated for this time interval. Before the transgression of the Mesozoic the relief was reduced to a peneplain, and this was followed by rather quiet subsidence that lasted for almost 200 my, although probably interrupted in the Cretaceous. It was followed by renewed tectonic activity in the Paleogene. Between the late Eocene and the early Miocene there was a largely extensional period which is documented for the Alps and their northern, western and southern foreland. In this period, a number of the Paleozoic fault zones were reactivated, mainly as comparatively gentle flexures which were accentuated by minor faults. This relief was peneplained again before the Langhian. With the middle Miocene, an entirely new tectonic situation originated ('Miocene revolution'). The stress field was re-oriented. In the area of the southern Rhinegraben a large dome, rooting in the lithosphere, began to rise (Black Forest-Vosges dome). The Alps began again a part of the compressive Africa-Europe plate boundary (Neo-Alps). Their northern front progressively penetrated the foreland, and their final addition, in the late Miocene, was the decollement nappe of the Jura. The sole of this thrust sheet had been strongly disturbed by the Paleogene deformations. 46 refs., 8 figs.

38177 (NAGRA-NTB—87-15, pp 323-334) **Cataclasis in the crystalline basement of Northern Switzerland.** Meyer, J. (Bern Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

In the crystalline basement of Northern Switzerland two main phases of cataclastic deformation can be distinguished: a 'cataclasis 1' in a higher temperature hydrothermal regime, as a consequence of tectonic and magmatic-hydrothermal events in Upper Carboniferous time and a lower temperature 'cataclasis 2', which can be related to Permian tectonics at the northern margin of the Paleozoic Konstanz-Frick trough. These cataclases are interpreted as a result of longlasting and complex tectonic processes at shallow crustal levels. (author) 30 refs., 4 figs.

38178 (NAGRA-NTB—87-15, pp 383-395) **Diagenesis of Buntsandstein and its relation to the tectonic evolution of Northern Switzerland.** Ramseyer, K. (Bern Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

In Northern Switzerland a large southward extension of Buntsandstein sediments below the Jura mountains is recorded from six Nagra boreholes and the Pfaffnau 1 oil exploration well. Most of the sediments comprise reworked quartz rich sandstones deposited in a fluvial environment. During eogenesis pedogenic processes modified the sediments under semiarid conditions with the localized displacive growth of nodular carbonate, sulphate and chalcedony. Clay introduced by mechanical infiltration was penecontemporaneously reddened. Two cycles of precipitation dissolution took place during mesogenesis. Both cycles include precipitation of quartz, carbonate and sulphate, and additionally, in the second cycle, kaolinite and locally a variety of ore minerals. During formation of secondary porosity both potassium feldspar and authigenic cements were partially dissolved. Late tectonic fractures are now cemented with quartz, chalcedony and calcite. Fluids responsible for the formation of secondary porosity are inferred to have migrated along fractures from the underlying organic rich Permo-Carboniferous sediments during stages of maximum burial and inversion. Following inversion, a final generation of secondary porosity developed throughout the Buntsandstein by dissolution of calcite and anhydrite. This dissolution is related to an influx of low salinity waters. (author) 29 refs., 10 figs.

38179 (NAGRA-NTB—87-15, pp 461-472) **On seismotectonics of Northern Switzerland.** Pavoni, N. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Comparison of focal mechanisms with local neotectonic structures in Northern Switzerland shows, in many cases, a good correlation between the orientation of nodal planes of the fault-plane solutions and the orientation of fault systems observed at the surface. Focal depths of 10-30 km indicate that some of these fault systems cut deep into the crystalline basement and even through the whole crust. From the orientation of P-axes and T-axes it is concluded that the crust of northern Switzerland is undergoing a NNW-SSE maximum horizontal shortening and a WSW-ENE maximum horizontal extension. The orientation of the stress field which causes the present seismicity in northern Switzerland is very similar to that of the stress field of the last 5 to 8 million years which produced the neotectonic deformation. (author) 22 refs., 3 figs., 1 tab.

38180 (NAGRA-NTB—87-15, pp 473-489) **Decoupling of the tectonic stress field at the Jura overthrust.** Mueller, W.H.; Bluemling, P.; Becker, A.; Clauss, B. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland); Karlsruhe Univ. (T.H.) (Germany, F.R.)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

This study documents the three-dimensional structure of the tectonic stress field in northern Switzerland. Investigations in the basement are in good agreement with other studies of the stress field in Central Europe (135 degrees), also significant rotations of the stress field were observed in the sediments. Minor rotations of the stress tensor are attributed to local effects of the concealed Permo-Carboniferous (horizontal stress direction 160 degrees) trough beneath northern Switzerland while a more pronounced change of the orientation of the stress field is apparent in the sediments south of the Jura collision front (horizontal stress direction 10 degrees). This rotation is possibly due to a decoupling of the stresses by the decollement horizon within the evaporate series of the Keuper and the Mittlere Muschelkalk. (author) 40 refs., 8 figs., 1 tab.

38181 (NAGRA-NTB—87-15, pp 491-508) **Method for estimation of tectonic shear strain based on microstructural observations.** Jordan, P. (Basel Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

The relative competence between certain rocks or minerals inverts when particular confining conditions are reached. Anhydrite, for example, deforms at a higher stress level in the cataclastic field than clay. With increasing burial depth, anhydrite enters the field of crystal plasticity and its strength decreases rapidly, while clay keeps on deforming by cataclasis at increasingly higher stresses and becomes finally stronger than anhydrite. This inversion of strength is a function of temperature, pore pressure, confining pressure as well as of strain rate. The inversion of relative competence may, therefore, be used as a valuable dynamic indicator, provided that the ambient conditions effective during deformation are sufficiently known. Based on experimentally deduced flow laws, equilibrium point maps may be calculated for the maximum or minimum strain rate implied by the observed microstructures. The map presented here allows a good estimation of the influences of all the uncertainties in pressure or temperature on the critical strain rate. An application of the anhydrite-clay equilibrium point map on the detachment horizon of the Eastern Jura Mountains (NW Switzerland) implies a maximum simple shear strain rate of ca. $3x10^{-14}s^{-1}$, or ca. $6x10^{-12}s^{-1}$, depending upon the differing paleo-temperature estimates. The first estimate is based on the present geothermal gradient, while the second one is based on fluid inclusions which are considered to be related to the Miocene detachment. (author) 28 refs., 5 figs.

38182 (NAGRA-NTB—87-15, pp 509-519) **Indications of neotectonic crust motion in Northern Switzerland.** Haldimann, P. (Geologisches Buero Dr. Heinrich Jaeckli AG, Zurich and Baden (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Indications of possible Pleistocene and Holocene tectonic activity in northern Switzerland have been found by an analysis of irregular erosional forms in the subcrop, abnormal gradients of accumulative gravel terraces and particular developments of the river course. (author) 6 refs., 3 figs., 1 tab.

38183 **(PB—88-196613/XAB) Nonseismic, surface geophysical, and geochemical prospecting technolygy. Final report, November 1986-November 1987.** Curtis, J.B.; Gevirtz, J.L. (Exlog/Brown and Ruth Labs., Inc., Englewood, CO (USA)). Dec 1987. 107p. NTIS, PC A06/MF A01.

The exploration value of detecting low concentrations of hydrocarbons entrapped in soils has been subject to considerable debate. Proponents of the various methods assert that microseepage involves vertical migration of hydrocarbons, a mode of hydrocarbon movement that is different than that documented for macroseeps. Earlier studies have suffered from less-than-rigorous sampling designs that lead to statistically untestable conclusions. And no universally acceptable genetic models that quantitatively relate asserted causes, mechanisms, and effects of microseepage have been defined. A series of experiments to complete an objective study are outlined in the document. The objective study is designed to: (1) Rigorously establish the genetic relationship between measurement of soil hydrocarbon populations and postulated soil alteration products and their geophysical and remote-sensing expression. This would allow us to: (2) Determine what these surface measurements tell us about the hydrocarbon character, geology and hydrodynamics of the subsurface. Results of such an experiment could then be used to: (3) Test the concept of vertical hydrocarbon migration and improve the application of microseep detection methods.

38184 **Inversion of regional Pnl and surface-wave data for source parameters of a Borah Peak aftershock.** Patton, H.J.; Doser, D.E. (Lawrence Livermore National Laboratory, California). *Geophysical Research Letters;* **15**: No. 5, 459-462(May 1988).

We present results of a comparative source study on one of the largest aftershocks of the Borah Peak, Idaho, earthquake series. The mechanism of this event had been previously studied using first motions and teleseismic p-wave data, and we report here our results from analysis of regional Pnl and surface waves. The Pnl waves gave an estimate of the source duration near 5 sec, in agreement with the teleseismic p-waves. Both the source duration and the effect of surface-wave dispersion through laterally heterogeneous crustal structures must be accounted for in the moment-tensor inversions of intermediate-period surface waves. All data sources, both long period and short, gave consistent source mechanisms, and the long periods also yield three independent and consistent source mechanisms, and the long periods also yield three independent and consistent estimates of the seismic moment. The results demonstrate the promise of formal source-parameter retrieval techniques applied to regional data for the study of earthquakes with magnitudes below the magnitude threshold of teleseismic source determinations. copyright American Geophysical Union 1988

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 36922, 37012

38185 **(CONF-8805139—1) Some equivalent circuit models for AC impedance analysis of pyrite/solution interface.** Chander, S.; Pang, J.; Briceno, A. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). 1988. Contract FG22-85PC80523. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010574/JAW.

From Symposium on electrochemistry in mineral and metal processing; Atlanta, GA, USA (15 May 1988).

Several equivalent circuit models are considered for analysis of the AC impedance spectra of pyrite/solution interface. These models take into account the presence of coating layers and the contributions from surface roughness and diffusion. An optimization procedure is described to estimate the parameters of the equivalent circuit, namely, the value of various resistors and capacitors. The procedure can also be used to identify the equivalent circuit which best describes the measured impedance spectra. The impedance results of a pyrite electrode in sodium carbonate and borate solutions are analyzed in terms of the parameters of an equivalent circuit. Such an analysis can be used to distinguish the type of processes which control reactions at the electrode.

38186 **(INIS-BR—1091) Patterns in the rare earth elements of the Serra do Carambei granite (Parana) and the others associated ignous rocks.** Pinto-Coelho, C.V.; Marini, O.J. (Brasilia Univ. (Brazil). Dept. de Geociencias). 1986. 11p. (In Portuguese). (CONF-8610278—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702788/JAW.

From 34. Brazilian congress of geology; Goiania, Brazil (12 Oct 1986).

The rare earth elements (REE) distribution patters in igneous rocks of the Serra do Carambei Granite area (Parana) were a very important tool to elucidate the genetic processes and the cogenetic relationships between these rocks. The porphyroid facies of the Cunhaporanga Granitoid Complex has a REE distribution pattern characterized by decreasing concentrations in direction to the heavy rare earth elements (HREE) and the smooth Eu negative anomalie, compatible with amphibole fractionation during the magma ascent and the incipient plagioclase fractionation. The REE pattern of the Serra do Carambei Granite is characterized by the strong Eu negative anomalie, by the light rare earth element (LREE) depletion and by the HREE increase. This shape of the REE patterns is frequently observed in Sn-W granites, according to French authors. However in the igneous rocks of the Serra do Carambei Granite area this is not true. "Rhyolite" dytes intrusives in the Serra do Carambei Granite exhibit REE pattern similar to the wall rock, indicating then the same genetic processes. The Castro Group rhyolites have REE patterns with decreasing concentrations in direction to the HREE and smooth Eu negative anomalie. The REE distribution patterns is against the consanguinity between the "rhyolites" intruded in the Serra do Carambei Granite and the rhyolites of the Castro Group and also between these rhyolites and the above mentioned Granite.

38187 (LBL—25311) Crack models for the failure of rocks in compression. Kemeny, J.M.; Cook, N.G.W. (Lawrence Berkeley Lab., CA (USA)). Dec 1986. Contract AC03-76SF00098. 15p. (CONF-870103—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012217/JAW.

From 2. international conference on constitutive laws for engineering materials; Tucson, AZ, USA (5 Jan 1987).

Fracture mechanics models are developed to analyze the post failure behavior of rocks under triaxial compression. We consider axially aligned sliding cracks as a model for the axial growth of microcracks and a collinear row of shear cracks at an angle to the direction of maximum compression, as a model for shear failure. It is found that the sliding crack model exhibits strain hardening and strain softening, while the shear crack model exhibits only strain softening. Also, we consider parallel columns of sliding cracks, and show that parallel interaction stabilizes the axial growth of cracks.

38188 (LBL—25312) Fracture stiffness and aperture as a function of applied stress and contract geometry. Hopkins, D.L.; Cook, N.G.W.; Myer, L.R. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 11p. (CONF-870625—20). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012022/JAW.

From 28. U.S. symposium on rock mechanics; Tucson, AZ, USA (29 Jun 1987).

An analytical model that assumes variable height asperities and full interaction between them has been developed and implemented numerically to study the behavior of a single fracture under stress. The model has been used to calculate specific stiffness and aperture profiles for specified fracture geometries. The formulation takes account of the deformation of the half-planes defining the fracture which is shown to lead to changes in aperture geometry that are not predicted by other asperity models. A parameter sensitivity stud shows that specific stiffness varies significantly depending on the size of the asperities, their height distribution, and their spatial orientation. Curves of stress vs. specific stiffness generated with the model are found to agree in shape and magnitude with those obtained in the laboratory for rock specimens.

38189 (NAGRA-NTB—87-15, pp 305-322) Crystalline of Northern Switzerland: petrography and hydrothermal transformations. Peters, Tj. (Bern Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

The petrography of the crystalline basement of Northern Switzerland, which is overlain by a sedimentary cover, was studied from cores of deep drillings. The gneisses encountered mainly consist of metapelites, originating from illitic clays and biotite-plagioclase gneisses of dolomitic marl composition. They are interbedded with pyroxene-bearing lime silicate rocks and amphibolites interlain with aplitic gneisses, the latter being interpreted as bimodal volcanic tuffs. These gneisses, together with coarse-grained orthogneisses, were metamorphosed in upper amphibolitic facies up to anatexis. The gneisses are intruded by Variscan granites and a basic suite of diorites, monzonites and syenites. Several types of granites could be discriminated which are related to granites in the southern Black Forest. The slightly older basic rocks must have originated from an alkali basalt magma strongly enriched in K, P, Ba and Sr, to which, apart from mantle material, either the lower crust or a subduction component contributed. Emphasis was laid on the study of the hydrothermal alterations which had affected the crystalline. Four stages could be recognized: 1. A pegmatitic-pneumatolytic phase characterized by the growth of muscovite at the expense of K-spar and biotite and by the occurrence of tourmoline. 2. A hot-hydrothermal stage, where the anorthite-rich cores of plagioclase were transformed into sericite, calcite and albite, and biotite transformed into chlorite, K-spar, a Ti-phase and fluorite. 3. The main hydrothermal stage, where plagioclase was argillized into illite/smectite interstratifications and illite or was albitized. 4. Calcite and quartz veins with clay minerals and associated fissures with siderite, celestite, baryte, sphalerite, galenit.

38190 Positional disorder of A-site cations in C2/M amphiboles: model energy calculations and probability studies. Docka, J.A.; Post, J.E.; Bish, D.L.; Burnham, C.W. (Harvard Univ., Cambridge, MA (USA)). *American Mineralogist;* 72: No. 9-10, 949-958(Sep-Oct 1987).

Positional disorder of cations occupying the A sites of C2/m amphiboles has been modeled using structure-energy minimization techniques. Model energy calculations show that, relative to a tremolite end member, local charge deficiency on the T, M4, or O3 sites or charge excess on the M2 sites due to cation substitution will cause cations occupying the A site to assume positions significantly different from the 2b (2/m) special position. Calculations suggest that when a local charge configuration in the second-nearest neighbors of the A-site cation can be related by a symmetry element or combination of elements, the position of the A-site cation that results in minimum energy lies on that element or combination of elements, either 2b (2/m), 4g (2), or 4i (m), whereas a locally asymmetric charge configuration will favor the A-site cation to occupy a general position, 8j. Positional disorder may also be caused by different A-site cation species occupying distinctly different positions. K atoms need not be constrained to the mirror plane. Limiting-case probability calculations combined with the above conclusions suggest that for both richterite and edenite, the most probable position for the A-site cation is the general position, 8j, although in a significant fraction of cases, the A-site cation will occupy the 4g (2), 4i (m), or 2b (2/m) special positions.

38191 Neutron and x-ray diffraction study of hydrogarnet $Ca_3Al_2(O_4H_4)_3$. Lager, G.A.; Armbruster, T.; Faber, J. (Univ. of Louisville, KY (USA)). *American Mineralogist;* 72: No. 7-8, 756-765(Jul-Aug 1987). Contract W-31-109-ENG-38.

The crystal structure of $Ca_3Al_2(_4D_4)_3$ was refined from time-of-flight neutron powder data collected at 300, 200, and 100 K. The D atom is located 0.906(1) A (300 K) from oxygens surrounding the vacant anti 4 tetrahedral site. With the complete replacement of Si^{4+} by $4H^+$ in the grossular structure, the tetrahedral d-O distance increases from 1.645 to 1.950 A. Structural adjustments in response to tetrahedral expansion include a decrease in the length of the shared octahedral edge relative to the unshared edge and a corresponding increase in the Ca(1)-O(4) distance in the dodecahedron. At low temperatures, the D tetrahedron rotates $\sim 1°$ about the anti 4 axis relative to the rigid oxygen tetrahedron and becomes slightly more regular. The O-D distances at 300 and 100 K are within one standard deviation. Single-crystal X-ray intensity data were also obtained at 300 K from the same sample used in the neutron-diffraction experiments. The short O-H distance (0.65 A) determined from the X-ray data is characteristic of mineral structures with non-H-bonded OH groups and OH groups with weak O-H...O interactions.

38192 Effects of quench methods on Fe^{3+}/Fe^{2+} ratios: a Moessbauer and wet-chemical study. Dyar, M.D.; Naney, M.T.; Swanson, S.E. (Univ. of Oregon, Eugene (USA)). *American Mineralogist;* 72: No. 7-8, 792-800(Jul-Aug 1987). Contract AC05-84OR21400.

The effect of quenching method on Fe^{3+}/Fe^{2+} ratios in three silicate glasses has been studied using natural rock compositions. Samples were equilibrated at high temperatures and then quenched into an air jet, a 4% H_2-96% Ar jet, or a brine and ice bath. The glasses were analyzed by both Moessbauer spectroscopy and a microcolorimetric technique to compare the results from these commonly used methods for Fe^{3+}-Fe^{2+} determinations. Because the glasses were low in Fe^{3+} content, both analytical methods determined Fe^{3+} estimates by difference, resulting in relatively large uncertainties. Within these uncertainties, estimates of Fe^{3+}/Fe^{2+} ratios determined by Moessbauer spectroscopy and microcolorimetry are the same. None of the quenching methods used was observed to produce significantly different partitioning of Fe^{2+} among tetrahedral and octahedral structural sites in the basalt glasses. The highest cooling rate (brine and ice bath) yielded the largest tetrahedral Fe^{2+} values. No observable effects of quenching rate were measured with the other glass compositions investigated.

5804 Geochemistry

REFER ALSO TO CITATION(S) 35596, 37747, 38185, 38191

38193 (CONF-8709264—1) Report on workshop on thermal property measurements. Robertson, E.C. (Westinghouse Hanford Co., Richland, WA (USA)). 1987. Contract AI06-87RL11473. 34p. NTIS, PC A03;3. Order Number DE88009559/JAW.

From Workshop on thermal property measurements; Richland, WA, USA (9 Sep 1987).

Results of thermogravimetric analysis of basalt is discussed. Heat capacity, thermal conductivity and thermal expansion are specifically addressed. (CBS)

38194 (NAGRA-NTB—87-15, pp 553-568) Fluid inclusion investigations in Nagra's boreholes of Northern Switzerland. Mullis, J. (Basel Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

Fluid inclusions studied in quartz and calcite from 6 Nagra-boreholes and the oil exploration well Pfaffnau in northern Switzerland were used to evaluate the evolution of fluid composition and trapping conditions. The studied boreholes covered representative sections of the Tertiary, Mesozoic and Permo-Carboniferous sedimentary rocks in addition to the underlying crystalline basement. Two fluid groups were identified, one containing salt-poor NaCl-(KCl) fluids of Upper Carboniferous age, and a second group containing salt-rich to salt-poor $CaCl_2$-NaCl-($MgCl_2$) fluids trapped between Permian and Tertiary times. The inclusions of the first group were trapped at relatively high temperatures (100 degrees to 350 degrees C, rarely up to 400 degrees C) and low pressures (probably below 1 kbar). Their widespread occurrence along healed fractures in rock forming minerals of the crystalline basement and in detrital quartz grains of the Permo-Carboniferous and Triassic sandstones imply a tectonicthermic event on a regional scale during late Variscan orogeny. The second group of fluids comprises early salt-rich and late salt-poor inclusions. The inclusions were trapped between 30 degrees and 140 degrees C and are detected preferentially in fissure minerals and porefilling cements. The widespread occurrence of the salt-poor fluids along healed fractures inside the host minerals imply major tectonic events especially during Tertiary times. These tectonic events are probably responsible for increased fluid migration and possibly also for brine dilution. The two fluid groups display a considerable similarity with the high-temperaturelow-saliniferous Variscan fluid system of the Black Forest and Oberpfalz. (author) 44 refs., 5 figs., 2 tabs.

38195 (NAGRA-NTB—87-15, pp 579-592) $^{87}Sr/^{86}Sr$-ratios and Sr-contents of deep ground waters, minerals and rocks from the crystalline and the Trias of Northern Switzerland. Matter, A.; Peters, Tj.; Ramseyer, K. (Bern Univ. (Switzerland)). 1987. (In German). Nagra, CH-5401 Baden. (CONF-8610398—).

From Geology of northern Switzerland conference; Bern, Switzerland (9 Oct 1986).

In order to determine the origin of groundwaters and their interaction with the host rock, the amount and ratio of strontium isotopes in groundwaters, vein minerals, authigenic cements and whole rocks were measured in the crystalline basement and Triassic sediments of northern Switzerland. The groundwaters in the fractured basement aquifer generally show Sr-isotope ratios that range between 0.716 and 0.718. These ratios in the groundwaters are mainly determined by reaction with Sr-rich minerals that were formed during a Permian hydrothermal event. With minor exceptions, the Sr-isotope ratios of most vein minerals are not in equilibrium with those of the present groundwaters. The waters of the Buntsandstein aquifer are characterized by slightly lower Sr-isotope ratios and a higher Sr-content than in the corresponding basement aquifer waters. Buntsandstein waters are considered to have evolved from the waters of the basement aquifer through dissolution of calcite and sulphate present in the Buntsandstein. Although the Sr-isotope ratios in Buntsandstein vein minerals and waters are similar the relative amount of Sr (assuming equilibrium partitioning) suggests these vein minerals did not precipitate from the present waters. The much lower Sr-isotope ratio characteristic of waters in the Muschelkalk aquifer (0.708 to 0.709) readily distinguishes these from the Buntsandstein and basement waters. The low Sr-isotope ratios in the Muschelkalk waters are, however, higher than those measured from marine sulphates in the Muschelkalk, and may result from dissolution of dolomite and continental sulphates. Measured variations in the Sr-isotope ratios of successive authigenic minerals indicate that the Sr-isotope composition in the groundwaters fluctuated through geological time. (author) 32 refs., 4 figs., 1 tab.

38196 Dissolution kinetics of quartz as a function of pH and time at 70°C. Knauss, K.G.; Wolery, T.J. (Lawrence Livermore National Lab., CA (USA)). *Geochimica et Cosmochimica Acta;* **52**: No. 1, 43-53(JaJan 1988). Contract W-7405-ENG-48.

A single-pass, flow-through apparatus was used to determine the dissolution rate of quartz at 70°C as a function of pH and time. Dissolution rate data were obtained over the pH range 1.4 to 11.8 in nine separate experiments each lasting 50 days. The quartz dissolution rates were defined by the silica release rate to solution. Speciation-solubility calculations using the geochemical modeling code EQ36 indicate that the fluid was maintained far from equilibrium with respect to quartz and well-undersaturated with respect to all possible secondary minerals in all runs. The dissolution rates were independent of pH at values (10/sup -15.3/ molcm^2 x s) consistent with the data of Rimstidt and Barnes (1980) up to approximately pH 6, but at higher pH the rates increased with increasing pH, proportional to a/sub H^+//sup -0.5/, being almost four orders of magnitude higher at pH 11.8. The rate constants for quartz dissolution at 70°C were 10/sup -15.3/ molcm^2 x s in the pH-independent region extending from acid through neutral solutions, and 10/sup -17.8/ molcm^2 x s in more alkaline solutions. Etch pits were strongly developed in the runs with the more alkaline solutions (pH $>$ 8), in which the rates were the highest. This appears consistent with a surface reaction-controlled dissolution mechanism.

38197 Calculation of the thermodynamic and transport properties of aqueous species at high pressures and temperatures: aqueous tracer diffusion coefficients of ions to 1000°C and 5 kb. Oelkers, E.H.; Helgeson, H.C. (Univ. of California, Berkeley (USA)). *Geochimica et Cosmochimica Acta;* **52**: No. 1, 63-85(Jan 1988). Contract AS03-83ER13100;FG03-85ER13419.

Accurate values of diffusion coefficients for aqueous species are a requisite for predicting mass transfer in many geochemical processes. Tracer diffusion coefficients can be calculated from the limiting equivalent conductances of ions using the Nernst-Einstein equation. A corresponding states approach yields an isothermal/isobaric correlation between the limiting equivalent conductances and the standard partial molal entropies of aqueous species and electrolytes. These correlations, together with an equation of state for the standard partial molal entropies of aqueous species and a modified Arrhenius representation of the limiting equivalent conductances of aqueous electrolytes, can be used to predict as a function of temperature and pressure the limiting equivalent conductances of many electrolytes of geologic interest for which no high pressure/temperature experimental data are available. Combining these estimates with the linear dependence of the logarithm of the ratio of the anion to cation transference number for NaCl on reciprocal temperature observed by Smith and Dismukes permits prediction of the limiting equivalent conductances of ions, and therefore tracer diffusion coefficients at temperatures and pressures to 1000°C and 5 kb. Values of these coefficients are given in tables for 30 monovalent anions, monovalent cations, and divalent cations of geologic interest at high temperatures and pressures. The diffusion coefficients increase with increasing temperature by $\sim$ two orders of magnitude from 0° to 1000°C. In contrast, they decrease slightly with increasing pressure.

38198 Diploptene in antarctic sediments. Venkatesan, M.I. (Univ. of California, Los Angeles (USA)). *Geochimica et Cosmochimica Acta;* **52**: No. 1, 217-222(Jan 1988). Contract AS03-76EV70134.

The presence of diploptene [17β(H),21β(H)-hop-22(20)-ene] in sediment cores from Bransfield Strait and McMurdo Sound, Ant-

arctica, is reported. The organic geochemical data for these sediments provide evidence for the authigenic marine origin of this hopene.

38199 **Thermodynamics of concentrated electrolyte mixtures and the prediction of mineral solubilities to high temperatures for mixtures in the system Na-K-Mg-Cl-SO_4-OH-H_2O.** Pabalan, R.T.; Pitzer, K.S. (Lawrence Berkeley Lab., CA (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 9, 2429-2443(Sep 1987). Contract AC03-76SF00098.

Mineral solubilities in binary and ternary electrolyte mixtures in the system Na-K-Mg-Cl-SO_4-OH-H_2O are calculated to high temperatures using available thermodynamic data for solids and for aqueous electrolyte solutions. Activity and osmotic coefficients are derived from the ion-interaction model of Pitzer (1973, 1979) and co-workers, the parameters of which are evaluated from experimentally determined solution properties or from solubility data in binary and ternary mixtures. Excellent to good agreement with experimental solubilities for binary and ternary mixtures indicate that the model can be successfully used to predict mineral-solution equilibria to high temperatures. Although there are currently no theoretical forms for the temperature dependencies of the various model parameters, the solubility data in ternary mixtures can be adequately represented by constant values of the mixing term Phi/sub ij/ and values of Phi/sub ijk/ which are either constant or have a simple temperature dependence. Since no additional parameters are needed to describe the thermodynamic properties of more complex electrolyte mixtures, the calculations can be extended to equilibrium studies relevant to natural systems. Examples of predicted solubilities are given for the quaternary system NaCl-KCl-$MgCl_2$-H_2O.

38200 **Volatilization, transport, and sublimation of metallic and non-metallic elements in high temperature gases at Merapi Volcano, Indonesia.** Symonds, R.B.; Rose, W.L.; Reed, M.H.; Lichte, F.E.; Finnegan, D.L. (Michigan Technological Univ., Houghton (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 8, 2083-2101(Aug 1987).

Condensates, silica tube sublimates and incrustations were sampled from 500-800°C fumaroles and lava samples were collected at Merapi Volcano, Indonesia in January-February, 1984. With decreasing temperature (800-500°C) there were five sublimate zones found in silica tubes: 1) cristobalite and magnetite; 2) K-Ca sulfate, acmite, halite, sylvite and pyrite; 3) aphthitalite, sphalerite, galena and Cs-K sulfate; 4) Pb-k chloride and Na-K-Fe sulfate; and 5) Zn, Cu and K-Pb sulfates. The incrustations surrounding the fumaroles are also chemically zoned. Bi, Cd, Pb, W, Mo, Zn, Cu, K, Na, V, Fe and Mn are concentrated most in or very close to the vent as expected with cooling, atmospheric contamination and dispersion. Incomplete degassing of shallow magma at 915°C is the origin of most of the elements in the Merapi volcanic gas, although it is partly contaminated by particles or wall rock reactions. Devolatilization of a cooling batholith could transport enough acids and metals to a hydrothermal system to play a significant role in forming an ore deposit. However, sublimation from a high temperature, high velocity carrier gas is not efficient enough to form a large ore deposit. Re, Se, Cd and Bi could be used as supporting evidence for magmatic fluid transport in an ore deposit.

38201 **Stability of illite/smectite during diagenesis: an experimental study.** Sass, B.M.; Rosenberg, P.E.; Kittrick, J.A. (Battelle, Pacific Northwest Labs., Richland, WA (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 8, 2103-2115(Aug 1987).

Illites from Goose Lake (Illinois) and Beavers Bend (Oklahoma) were equilibrated in 0.2 M and 2.0 M KCl solutions with excess kaolinite and either gibbsite, boehmite, quartz, or amorphous silica. Teflon-lined reaction vessels were used to heat the charges from 25° to 250°C at the vapor pressures of solution. Partial reversibility was demonstrated by approaching equilibria from both high and low K^+H^+ activity ratios. The experimental data were used to construct isothermal, isobaric activity diagrams [log (a/sub K^+/a/sub H^+/) vs. log a/sub SiO_2/] for the system K_2O-Al_2O_3-SiO_2-H_2O. Stability regions have been defined for kaolinite, boehmite, and three other phases that are believed to be components of both illites. At low temperatures (<90°C) illite-smectite equilibrium is metastable with respect to calculated kaolinite-microcline equilibrium. Between 90°C and 110°C a phase transition involving illite and smectite occurs which stabilizes the assemblages illite-smectite-kaolinite and illite-smectite-microcline. This transition occurs at the same temperature as the ordering transition in natural IS. Above 110°C the assemblage illite-smectite is again metastable with respect to kaolinite-microcline, but at 200°C and above illite and smectite may coexist stably with either kaolinite or microcline. However, smectite decomposes where a/sub SiO_2/ is controlled to quartz solubility yielding the stable assemblage illite-kaolinite-quartz and illite-mica-quartz.

38202 **Effect of pressure on aragonite dissolution rates in sea water.** Acker, J.G.; Byrne, R.H.; Yaakov, S.B.; Feely, R.A.; Betzer, P.R. (Univ. of South Florida, St. Petersburg (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 8, 2171-2175(Aug 1987).

Aragonite dissolution in sea water at variable pressure is well described by the equation Rate = kappa'([CO_3^{2-}]s - [CO_3^{2-}])/sup n/ where [CO_3^{2-}]s is the carbonate ion concentration at saturation, [CO_3^{2-}] is the observed carbonate ion concentration, and kappa' and n are empirical constants. Application of the equation Rate = kappa(1-Omega)/sup n/ to descriptions of aragonite dissolution rates is appropriate at constant pressure, temperature and salinity. The authors measurements in sea water at 5°C are consistent with the estimate - $\Delta V = 36.5$ cm^3mole for the volume change accompanying aragonite dissolution. This result is somewhat higher than laboratory estimates, but lower than estimates based on calcite and the difference between calcite and aragonite molar volumes.

38203 **High-resolution ^{23}Na, ^{27}Al, and ^{29}Si NMR spectroscopy of framework aluminosilicate glasses.** Oestrike, R.; Yang, W.H.; Kirkpatrick, R.J.; Hervig, R.L.; Navrotsky, A.; Montez, B. (Univ. of Illinois, Urbana (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 8, 2199-2209(Aug 1987). Contract FG02-85ER13437.

The results of high-resolution ^{23}Na, ^{27}Al, and ^{29}Si NMR spectroscopy of aluminosilicate glasses with MO/Al_2O_3 or $L_2O/Al_2O_3 = 1$ (M = +2, L = +1 cations) shows that these glasses have a fully polymerized tetrahedral framework structure with only a defect level of non-bridging oxygens. The chemical shifts of the peak maxima for all three nuclides become less shielded with decreasing Si/(Si + Al). For ^{29}Si and ^{27}Al, this variation parallels the variation of framework crystalline silicates. The ^{23}Na chemical shifts for the glasses becomes less shielded (less negative) with decreasing Na/(Na + K), opposite to the trend for crystalline alkali feldspars. Few data exist for the ^{23}Na chemical shifts of crystalline samples, and the structural causes of variation in ^{23}Na chemical shifts are not well understood. The ^{27}Al and ^{29}Si chemical shifts of the glasses do not vary significantly with different large (modifier) cations. The ^{29}Si chemical shifts provide estimates of average Si-O-T (T = Si, Al) bond angles and Si-O bond distances, and the ^{27}Al and ^{29}Si chemical shifts and peak breadths are consistent with a decrease in the tetrahedral ring order with decreasing Si/(Si +Al). The data presented here for fully polymerized glasses form a base from which the data for aluminosilicate glasses containing both fully polymerized sites and less polymerized sites can be interpreted.

38204 **Mineral recorders of pegmatite internal evolution: REE contents of tourmaline from the Bob Ingersoll pegmatite, South Dakota.** Jolliff, B.L.; Papike, J.J. (South Dakota School of Mines and Technology, Rapid City (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 8, 2225-2232(Aug 1987). Contract FG01-84ER13259;AC06-76RL01830.

Trace rare earth elements (REE) have been determined by radiochemical neutron activation analysis for tourmaline samples from an internally zoned, rare-element, granitic pegmatite, located in the Black Hills, South Dakota. The Total REE concentrations range from 40 ppm-0.2 ppm, and are highest in tourmaline from the exomorphic halo (country rock) and pegmatite border zone. Chondrite-normalized patterns are highly fractionated from light REE to heavy REE; and REE concentrations decrease in tourmaline from the outer wall zone and first intermediate zone, through the inner wall zone and third intermediate zone, to lowest levels in the pegmatite core. The REEs, as recorded by tourmaline, appear to

behave compatibly in this pegmatite system due to early crystallization of apatite and other possible REE-sink minerals. The large range of REE concentrations and differences in slopes of chondrite-normalized patterns probably also reflect significant changes in the structural state of the pegmatite melt, caused by changes in pH_2O and other volatiles (B, F, P) as crystallization progressed. Tourmaline samples that appear to have been fluid-derived are HREE-depleted relative to coexisting silicate-melt-derived tourmaline. Tourmaline does not exhibit any strong preference for specific REEs, rather its REE content appears to reflect the REE content of the medium from which the tourmaline crystallized.

38205 Cycling of fallout (Pu, ^{241}Am, ^{137}Cs) and natural (U, Th, ^{210}Pb) radionuclides in Washington continental slope sediments. Carpenter, R.; Beasley, T.M.; Zahnle, D.; Somayajulu, B.L.K. (Univ. of Washington, Seattle (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 7, 1897-1921(Jul 1987).

This paper reports activity profiles of Pu isotopes, ^{241}Am, ^{137}Cs, ^{210}Pb, U and Th isotopes in Washington continental slope sediments from 332-1415 m water, identify major processes responsible for them, and compare results with those previously reported for Washington shelf sediments. Specific activities of all nuclides but ^{137}Cs are higher in slope surface sediments than shelf surface sediments. These higher specific activities, which are due to more efficient scavenging by finer grained particles and higher concentrations of dissolved nuclides in slope waters, do not cause proportionally higher slope sediment radionuclide inventories, because they are counterbalanced by 5-10 fold lower sediment accumulation rates on the slope. /sup 239,240/Pu activities and inventories in slope sediments correlate with those of excess ^{210}Pb, as in shelf sediments, but with higher ratios of ^{210}PbPu in slope deposits. ^{241}Am/sup 239,240/Pu activity and inventory ratios in slope sediments average twice ratios in shelf sediments, due primarily to greater particle affinity and preferential downward transport of ^{241}Am. AmPu activity ratios change little with depth in slope sediments, suggesting insignificant separation of the two nuclides during diagenesis. /sup 239,240/Pu^{137}Cs ratios are 2-3 times greater in slope than shelf sediments, due to a combination of preferential scavenging of Pu and greater ^{137}Cs loss b decay and desorption. PuCs activity ratios decrease with depth in more porous slope sediments, due to downward migration of ^{137}Cs.

38206 Thorium-uranium disequilibrium in a geothermal discharge zone at Yellowstone. Sturchio, N.C.; Binz, C.M.; Lewis C.H. III. (Argonne National Lab., IL (USA)). *Geochimica et Cosmochimica Acta;* **51**: No. 7, 2025-2034(Jul 1987). Contract W-31-109-ENG-38.

Whole rock samples of hydrothermally-altered Biscuit Basin rhyolite from Yellowstone drill cores Y-7 and Y-8 were analyzed for ^{230}Th, ^{234}U, ^{238}U, and ^{232}Th. Extreme disequilibrium was found, with (^{230}Th/^{234}U) ranging from 0.30 to 1.27. Values of (^{230}Th/^{232}Th) and (^{234}U/^{232}Th) define a linear correlation with a slope of 0.16 +/- 0.01, which corresponds to a (^{230}Th/^{234}) age of approximately 19 ka. The (^{230}Th/^{234}U) disequilibrium was apparently caused by U redistribution which occurred mostly at about 19 ka, and is not related simply to the relative degree of hydrothermal alteration and self-sealing of the rhyolite. Mass balance of U requires a large flux of U-bearing ground water through the rhyolite at the time of U redistribution; rough estimates of minimum water/rock ratio range from 10^2 to 10^4, for a range of possible ground water U concentrations. Conservative hydraulic calculations indicate that the required ground water flux could have occurred within a period of hundreds of years prior to self-sealing. The disequilibrium data are consistent with a model involving U redistribution during the initial stages of development of a geothermal discharge zone that formed in response to the hydrogeologic effects of glacial melting and unloading during the decline of the Pinedale Glaciation.

64 PHYSICS I

REFER ALSO TO CITATION(S) 38514

38207 (INIS-mf—11234) Italian Society of Physics. 53. National Congress. (Societa Italiana di Fisica, Bologna). 1987. 216p. (In Italian). (CONF-8710335—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702881/JAW.

From 53. national congress of the Italian Society of Physics; Naples, Italy (12 Oct 1987).

The abstracts of most of the papers read at the 53 National Congress of the Italian Society of Physics are presented. The Congress developed in ten sessions: high energy and elementary particle physics, physics of nuclei, condensed matter, quantum electronics, cosmic physics, geophysics, general physics, electronics and applied physics, health physics and hystory of physics. An author index is also included.

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 37228, 38454, 38466, 38467, 38543

38208 (AD-A—190540/5/XAB) Role of atomic and molecular processes in the Critical Ionization Velocity theory. Murad, E. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1987. 13p. (AFGL-TR—88-0007). NTIS, PC A03/MF A01.

Pub. in Recent Studies in Atomic and Molecular Processes, 79-90(1987).

In formulating a theory for the structure of the solar system (meaning the formation of the planets with their individual satellites) Alfven (1954; Alfven and Arrhenius, 1975) postulated a simple intuitive concept, the Critical Ionization Velocity (CIV), to explain the condensation of matter in the early stages of the formation of the solar system. Since the original suggestion fo CIV, it has been invoked to explain such diverse phenomena as cometary plasma (Formisano et al., 1982; Galeev et al., 1986) and the shuttle glow (Papadopoulos, 1984). Evidence, particularly from space experiments, has been reviewed recently by Newell (1985). Other reviews (e.g. Sherman, 1973) have emphasized the plasma (the collective) aspects of the theory. This review attempts to provide a transition from the collective aspects of the plasma treatments to the microscopic (collisional) implications of the theory.

38209 (AD-A—190632/0/XAB) Structure of the extended emission in the infrared celestial background. Price, S.D. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jan 1988. 13p. (AFGL-TR—88-0039). NTIS, PC A03/MF A01.

Pub. in Optical Engineering, Vol. 27, No. 1, 075-085(Jan 1988).

The extended infrared celestial emission is due to three main sources: zodiacal dust, large discrete objects in the galaxy, and interstellar dust. As viewed from earth orbit, the thermal reradiation of sunlight absorbed by dust in the solar system produces a pervasive IR background that peaks roughly along the ecliptic plane, where the density of dust is highest. Much-smaller-scale structure was also observed in both the visual and infrared. Between 7 and 30 micrometers, H II regions are the brightest discrete objects in the galaxy. An additional emission mechanism is needed, however, to account for the shorter-wavelength observations. The galactic sources combine along the line of sight to produce an intense band of emission, centered on the galactic plane. Structure in all of these backgrounds creates a clutter problem for an orbiting IR telescope.

38210 (CEA-CONF—9204) Sensitiveness to cosmic radiation: on some aspects of data collection and their representation. Leray, J.L.; Musseau, O.; Marti, A.; Coic, Y. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). Jul 1987. 20p. (In French). (CONF-870724—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752559/JAW.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

During simulation of cosmic radiation effects, the energy deposition by length unit is altered because of energy lowering along the range. This mechanism is illustrated by exhaustive data got from the microprocessor type 2901. Wrong conclusions may be deduced concerning behavior in space field. New representations of cross sections are presented; they lead to safer predictions on behavior in space environment.

38211 **(DOE/ER/40063—2) [Application of two-dimensional imaging to very high energy gamma ray astronomy]: Progress report, 1987-1988.** (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). [1988]. Contract AC02-82ER40063. 22p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010120/JAW.

The major accomplishment of this project was the development of a gamma camera for detection of very weak flux from the Crab Nebula. In addition, the detection of a pulsed flux from Hercules X-1 and the installation of a new high resolution camera are reported. 6 figs. (DWL)

38212 **(DOE/ER/40423—02-P8) Cosmological helium production simplified.** Bernstein, J.; Brown, L.S.; Feinberg, G. (Stevens Inst. of Tech., Hoboken, NJ (USA); Rockefeller Univ., New York (USA); Washington Univ., Seattle (USA); Columbia Univ., New York (USA). Dept. of Physics). 1988. Contract AS06-88ER40423. 39p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009578/JAW.

We present a simplified model of helium synthesis in the early universe. The purpose of the model is to explain clearly the physical ideas relevant to the cosmological helium synthesis, in a manner that does not overlay these ideas with complex computer calculations. The model closely follows the standard calculation, except that it neglects the small effect of Fermi-Dirac statistics for the leptons. We also neglect the temperature difference between photons and neutrinos during the period in which neutrons and protons interconvert. These approximations allow us to express the neutron-proton conversion rates in a closed form, which agrees to 10% accuracy or better with the exact rates. Using these analytic expressions for the rates, we reduce the calculation of the neutron-proton ratio as a function of temperature to a simple numerical integral. We also estimate the effect of neutron decay on the helium abundance. Our result for this quantity agrees well with precise computer calculations. We use our semi-analytic formulas to determine how the predicted helium abundance varies with such parameters as the neutron life-time, the baryon to photon ratio, the number of neutrino species, and a possible electron-neutrino chemical potential. 19 refs., 1 fig., 1 tab.

38213 **(FRCEA-TH—44) Two enigmas of stellar evolution: the solar neutrinos and 1987 a supernova.** Cahen, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-7 Univ., 75 (France)). 30 Jun 1987. 126p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753963/JAW.

Solar models have been compared, using more recent opacity tables. Parameters to enter have been reviewed (thermonuclear reaction rate and element abundance) and opacity coefficient has been corrected. Incertitude influence of parameters on model results has been estimated. Helium initial abundance deduced from our model is coherent with observation and other calculated values. Causes of differences between some models are elucidated. For 1987a supernova, a semi-analytical model of light curve is presented. Light curve of supernovae whose progenitor is a massive star with a low initial radius. Electron recombination can explain almost the whole light emission.

38214 (INIS-BR—1018, pp 26) **Qualitative analysis of cosmological models in the Brans-Dicke theory.** Romero, C. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38215 (INIS-BR—1018, pp 35) **Study of the Ibitira meteorite (achondrite) by Moessbauer spectroscopy and x-ray diffraction.** Costa, T.V.V.; Vieira, V.W.A.; Araujo, M.A.B. de. (Ceara Univ., Fortaleza (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38216 (INIS-BR—1018, pp 16) **Detection of atmospheric cascades using Cerenkov radiation.** Santos, I.R.S.; Luksys, M.; Brito, A.A.S. 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38217 (INIS-mf—11219, pp 223-234) **Phase comparisons at extreme conditions.** Engelbrecht, J.R.; Engelbrecht, C.A. (Institute for Theoretical Physics, University of Stellenbosch, South Africa). 1987. (In Afrikaans). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

At the high temperature and density present in the cores of massive stars in the latter stages of their evolution matter is expected to be in equilibrium. Various methods describing this equilibrium and the resulting equation of state of stellar matter at extreme conditions are reviewed. From these descriptions the relative abundances of nucleons bound in nuclei and of unbound nucleons can be calculated, leading to predictions of the composition of collapsing stellar material.

38218 (INIS-mf—11223, pp 363-375) **Monopole bounds from the fast binary pulsar PSR 1953 + 29.** Drukier, A.K.; Raffelt, G.G. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

We consider the monopole contamination of the normal sequence, ca.1 M/sub sun/ companion star of the fast binary pulsar PSR 1953 + 29. We find that the photosphere of this star is practically monopole free,i.e. the number ratio r of photospheric monopoles to nucleons is $r < 3 \times 10^{-29}$. If the Rubakov effect exists at the predicted level, the much stronger limit $r < 1.2 \times 10^{-42}$ is obtained and the Galactic isotropic flux is bounded by $F < 1.3 \times 10^{-20}\,cm^{-2}\,sr^{-1}\,s^{-1}$. 43 refs.

38219 **(ITEP—87(1987)) Strange, quark and metastable neutron stars.** Krivoruchenko, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702404/JAW.

Observable consequences of possible existence of strange, quark, and metastable neutron stars are discussed. Bose condensation of dibaryons in dense nuclear matter is taken into account. The data on glitches from pulsar in Crab Nebula are used to obtain limits on binding energy of stable strange matter and on masses of dibaryon resonances. Scenario for two step collapse of supernova SN 1987 a is suggested. Masses of diagonal neutrinos are extracted from the data on second neutrino burst observed from supernova SN 1987 a. 24 refs.; 2 figs.

38220 **(JINR—R-13-87-404) Acoustic-optical detector of gravitational waves based on high-quality crystals.** Lyablin, M.V.; Shabalin, D.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702459/JAW.

Submitted to the journal Sov. J. Quant. Electron. .

A design of the detector of gravitational waves based on the optical interferometer with a crystal of high-quality acoustic and optical parameters as a sensitive element is analysed. The gravitational wave frequency being 10^7 rads^{-1}, the maximum Brown noise sensitivity of the detector to the gravitational flux is shown to be able to attain 10^{-2}-10^{-1} ergxcm^{-2}s^{-1} in the frequency band 2 x 10^{-4} Hz. 23 refs.; 3 figs.; 3 tabs.

38221 (LA-UR—88-1210) The classical nova outburst. Starrfield, S.G. (Los Alamos National Lab., NM (USA)). 11 Apr 1988. Contract W-7405-ENG-36. 30p. (CONF-8708243—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88009138/JAW.

From Multiwavelength astrophysics; Taos, NM, USA (11 Aug 1987).

The classical nova outburst occurs on the white dwarf component in a close binary system. Nova systems are members of the general class of cataclysmic variables and other members of the class are the Dwarf Novae, AM Her variables, Intermediate Polars, Recurrent Novae, and some of the Symbiotic variables. Although multiwavelength observations have already provided important information about all of these systems, in this review I will concentrate on the outbursts of the classical and recurrent novae and refer to other members of the class only when necessary. 140 refs., 1 tab.

38222 (LA-UR—88-1345) Uses of lunar sulfur. Vaniman, D.T.; Pettit, D.R.; Heiken, G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 20p. (CONF-8804104—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009119/JAW.

From NASA symposium on lunar bases and space activities of the 21st century; Houston, TX, USA (5 Apr 1988).

Sulfur and sulfur compounds have a wide range of applications for their fluid, electrical, chemical and biochemical properties. Although low in abundance on the Moon ({approximately}0.1% in mare soils), sulfur is surface-correlated and relatively extractable. Co-production of sulfur during oxygen extraction from ilmenite-rich soils could yield sulfur in masses up to 10% of the mass of oxygen produced. Sulfur deserves serious consideration as a lunar resource. 29 refs., 3 figs.

38223 (LBL—25375) Astrophysical evidence on the equation of state. Glendenning, N.K. (Lawrence Berkeley Lab., CA (USA)). 3 Jun 1988. Contract AC03-76SF00098. 6p. (CONF-880639—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011960/JAW.

From International conference on contemporary topics in nuclear structure physics; Cocoyoc, Mexico (9 Jun 1988).

The current situation concerning supernova simulations and the theory of neutron star structure are studied with respect to what they tell about the equation of state. A new mechanism that could help power supernovae is suggested.

38224 (RAL—88-014) Solar wind on 1 November 1984: observations by the AMPTE-UKS spacecraft. Bryant, D.A.; Bingham, R.; Farrugia, C.J. (Rutherford Appleton Lab., Chilton (UK)). Jan 1988. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753519/JAW.

Submitted to Journal of Geophysical Research.

The AMPTE-UKS spacecraft was well place to monitor the solar wind and its variations during the unusual compression of the earth's magnetosphere on 1 November 1984. Ions, electrons, magnetic fields and plasma waves observed between 0815 and 1300 UT upstream from the bow shock at geocentric distances of 14-19 Rsub(e) and magnetic local times ~ 0900 MLT are reported and assessed with respect to magnetopause and bow-shock crossings closer to the earth by the AMPTE-CCE.

38225 (SLAC-PUB—4606) Solar monopoles and terrestrial neutrinos. Frieman, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1988. Contract AC03-76SF00515. 4p. (CONF-8709275—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010677/JAW.

From Extra solar neutrino astronomy workshop; Los Angeles, CA, USA (30 Sep 1987).

Magnetic monopoles captured in the core of the sun may give rise to a substantial flux of energetic neutrinos by catalyzing the decay of solar hydrogen. We discuss the expected neutrino flux in underground detectors under different assumptions about solar interior conditions. Although a monopole flux as low as F/sub M/ {approximately} 10/sup {minus/24} cm/sup {minus/2} sec/sup {minus/1} sr/sup {minus/1} could give rise to a neutrino flux above atmospheric background, due to M{bar M} annihilation, this does not translate into a reliable monopole flux bound stronger than the Parker limit. 8 refs., 1 fig.

38226 (UCRL—98783) Dynamical evolution of cosmic strings. Bouchet, F.R. (Lawrence Livermore National Lab., CA (USA)). 11 May 1988. Contract W-7405-ENG-48. 12p. (CONF-8803113—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011724/JAW.

From 8. Moriond astrophysics meeting on dark matter; Les Arcs, France (6 Mar 1988).

The author have studied by means of numerical simulations the dynamical evolution of a network of cosmic strings, both in the radiation and matter era. Our basic conclusion is that a scaling solution exists, i.e., the string energy density evolves as t^{-2}. This means that the process by which long strings dump their energy into closed loops (which can gravitationally radiate away) is efficient enough to prevent the string domination over other forms of energy. This conclusion does not depend on the initial string energy density, nor on the various numerical parameters. On the other hand, the generated spectrum of loop sizes does depend on the value of our numerical lower cutoff (i.e., the minimum length of loop we allow to be chopped off the network). Furthermore, the network evolution is very different from what was assumed before), namely the creation of a few horizon sized loops per horizon volume and per hubble time, which subsequently fragment into about 10 smaller daughter loops. Rather, many tiny loops are directly cut from the network of infinite strings, and it appears that the only fundamental scale (the horizon) has been lost. This is probably because a fundamental ingredient had been overlooked, namely the kinks. These kinks are created in pairs at each intercommutation, and very rapidly, the long strings appear to be very kinky. Thus the number of long strings per horizon is still of the order of a few, but their total length is fairly large. Furthermore, a large number of kinks favors the formation of small loops, and their sizes might well be governed by the kink density along the long strings. Finally, we computed the two-point correlation function of the loops and found significant differences from the work of Turok.

38227 (UCRL—98784) Non-linear scale invariance in a cold-dark-matter universe. Bouchet, F.R. (Lawrence Livermore National Lab., CA (USA)). 11 May 1988. Contract W-7405-ENG-48. 7p. (CONF-8803113—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88011725/JAW.

From 8. Moriond astrophysics meeting on dark matter; Les Arcs, France (6 Mar 1988).

The observed decomposition of the lowest (N = 3,4) N-point correlation functions in symmetrized (N - 1) products of two-point correlation functions suggest the possibility that the Universe may obey a specific scale invariance, at least in some range. Assuming that this scale invariance is strictly verified for all N, some specific predictions concerning the void probability function P(sub O), and more generally the count probabilities P(sub N), as well as the fractal dimensions of the system can be made. In this report, the authors investigate the possibility that the non-linear evolution in a CDM Universe indeed to such a scale invariance.

38228 (UCRL—98811) Evolution of heavy-element abundances in the galactic halo and disk. Mathews, G.J.; Cowan, J.J.; Schramm, D.N. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 8p. (CONF-8803113—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011736/JAW.

From 8. Moriond astrophysics meeting on dark matter; Les Arcs, France (6 Mar 1988).

The constraints on the universal energy density and cosmological constant from cosmochronological ages and the Hubble age are reviewed. Observational evidence for the galactic chemical evolution of the heavy-element chronometers is described in the context of numerical models. The viability of the recently discovered Th/Nd stellar chronometer is discussed, along with the suggestion

that high r-process abundances in metal-poor stars may have resulted from a primordial r-process, as may be required by some inhomogeneous cosmologies.

38229 **Limits on the neutrino magnetic moment from SN1987A.** Lattimer, J.M.; Cooperstein, J. (Department of Earth and Space Sciences, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review Letters;* **61**: No. 1, 23-26(4 Jul 1988).

A neutrino magnetic moment greater than 10/sup -12/μ/sub B/, the Bohr magneton, would have important implications for gravitational-collapse supernovae. Also, it has been suggested that μ/μ/sub B/∼10/sup -10/ might solve the solar neutrino problem. However, we show that the neutrino observations of SN1987A and general optical observations of supernovae set a firm upper limit of μ/μ/sub B/<5 x 10/sup -13/. This limit is about 100 times better than the best experimental determination and previous astrophysical limits, and 10—20 times better than a previous limit based on big-bang nucleosynthesis.

38230 **Asymmetries in the location of the Venus ionopause.** Phillips, J.L.; Luhmann, J.G.; Knudsen, W.C.; Brace, L.H. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. A5, 3927-3941(1 May 1988).

Four large data sets of Venus ionopause observations, based on different definitions and observations by Pioneer Venus orbiter field and particle instruments, are compared. Regardless of the definition chosen, the ionopause is observed to be higher on average at dawn than at dusk. The results of an empirical ionosphere model and a data analysis technique which minimizes orbital bias are combined to show that most or all of this asymmetry results from the effects of orbital bias and uneven sampling of solar wind conditions. However, an additional asymmetry is found in which the ionopause is displaced in the direction opposite to the motional electric field of the solar wind. This effect is attributed to asymmetric pickup of exospheric ions by the electric and magnetic fields in the magnetosheath. This ion pickup interpretation can be understood in terms of a previously observed magnetosheath magnetic field asymmetry. Quantitative analysis indicates that the transverse momentum imparted by the solar plasma to pickup particles in their initial gyration is transmitted by the magnetosheath magnetic field to the ionosphere boundary. copyright American Geophysical Union 1988

38231 **Cosmic strings and the microwave sky. I. Anisotropy from moving strings.** Stebbins, A. (NASA/Fermilab Astrophysics Center, Batavia, IL (USA)). *Astrophysical Journal;* **327**: 584-614(Apr 1988).

A method is developed for calculating the component of the microwave anisotropy around cosmic string loops due to their rapidly changing gravitational fields. The method is only valid for impact parameters from the string much smaller than the horizon size at the time the photon passes the string. The method makes it possible to calculate the temperature pattern around arbitrary string configurations numerically in terms of one-dimensional integrals. This method is applied to temperature jump across a string, confirming and extending previous work. It is also applied to cusps and kinks on strings, and to determining the temperature pattern far from a strong loop. The temperature pattern around a few loop configurations is explicitly calculated. Comparisons with the work of Brandenberger et al. (1986) indicates that they have overestimated the MBR anisotropy from gravitational radiation emitted from loops. 24 references.

38232 **G54.1 + 0.3 - a new Crab-like supernova remnant.** Velusamy, T.; Becker, R.H. (Tata Institute of Fundamental Research, Udhagamandalam (India); Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA)). *Astronomical Journal;* **95**: 1162-1166(Apr 1988).

High-resolution multifrequency observations with the VLA and OSRT of the small-diameter flat-spectrum radio source G54.1 + 0.3 are presented. The filled-center brightness distribution, strong polarization at 6 cm, and flat radio spectrum (alpha of about -0.13) from 0.327 to 5 GHz confirm that G54.1 + 0.3 is a Crab-like supernova remnant. 22 references.

38233 **Cosmic string induced peculiar velocities.** Van Dalen, A.; Schramm, D.N. (NASA/Fermi National Accelerator Lab., Batavia, IL (USA)). *Astrophysical Journal;* **326**: 70-76(Mar 1988).

This paper considers the scenario of a flat universe with a network of heavy cosmic strings as the primordial fluctuation spectrum. The joint probability of finding streaming velocities of at least 600 km/s on large scales and local peculiar velocities of less than 800 km/s is calculated. It is shown how the effects of loops breaking up and being born with a spectrum of sizes can be estimated. It is found that to obtain large-scale streaming velocities of at least 600 km/s, it is necessary that either a large value for beta G mu exist or the effect of loop fissioning and production details be considerable. 32 references.

38234 **Collective emission of electromagnetic waves from astrophysical jets - ;uminosity gaps, BL Lacertae objects, and efficient energy transport.** Baker, D.N.; Borovsky, J.E.; Benford, G.; Eilek, J.A. (Los Alamos National Lab., NM (USA); California Univ., Irvine (USA); New Mexico Institute of Mining and Technology, Socorro (USA)). *Astrophysical Journal;* **326**: 110-124(Mar 1988).

A model of the inner portions of astrophysical jets is constructed in which a relativistic electron beam is injected from the central engine into the jet plasma. This beam drives electrostatic plasma wave turbulence, which leads to the collective emission of electromagnetic waves. The emitted waves are beamed in the direction of the jet axis, so that end-on viewing of the jet yields an extremely bright source (BL Lacertae object). The relativistic electron beam may also drive long-wavelength electromagnetic plasma instabilities (firehose and Kelvin-Helmholtz) that jumble the jet magnetic field lines. After a sufficient distance from the core source, these instabilities will cause the beamed emission to point in random directions and the jet emission can then be observed from any direction relative to the jet axis. This combination of effects may lead to the gap turn-on of astrophysical jets. The collective emission model leads to different estimates for energy transport and the interpretation of radio spectra than the conventional incoherent synchrotron theory. 54 references.

38235 **Effects of nuclear equation of state on general relativistic stellar core collapse models.** Van riper, K.A. (Los Alamos National Lab., NM (USA)). *Astrophysical Journal;* **326**: 235-240(Mar 1988).

The consequences of the equation of state above nuclear density, parameterized by a compressibility and an adiabatic index, for the strength of the reflected shock wave following core bounce in stellar collapse are studied using a hydrodynamic model. Particular attention is paid to the amplification of the shock strength when bounce occurs near those critical parameters which would result in continued collapse to the black hole. Comparisons are made to models where Newtonian hydrodynamics is assumed, and the relativistic effects are contrasted with the dependence on the homologous core mass. The dependence of the collapsed core mass (and the Newtonian shock strength) on the (constant) electron fraction Y(e) is shown. 22 references.

38236 **Dual nature of the supernova remnant G351.2 + 0.1.** Becker, R.H.; Helfand, D.J. (California, Univ., Davis (USA); Lawrence Livermore National Lab., CA (USA); Columbia Univ., New York, NY (USA)). *Astronomical Journal;* **95**: 883-886(Mar 1988).

The Galactic SNR G351.2 + 0.1 has been imaged at frequencies of 1.4, 5, and 15 GHz. The images reveal a source composed of two distinct components: a broken elongated shell measuring 4 x 6 arcmin and a central core about 15 arcsec in diameter. The two components are spectrally distinct. The shell has a nonthermal spectrum (alpha = -0.4) typical for Galactic SNRs, while the central core has an inverted spectrum (alpha = +0.27). The central core may be an analog of the Crab Nebula (a synchrotron nebula powered by a pulsar), but if so it is not typical of such objects. 10 references.

38237 **Pulsational stability of Wolf-Rayet stars.** Cox, A.N.; Cahn, J.H. (Los Alamos National Lab, NM (USA); Illinois Univ., Urbana (USA)). *Astrophysical Journal;* **326**: 804-812(Mar 1988).

Representative radial and nonradial pulsational modes of five WR star models are calculated. In agreement with Maeder (1984), a hydrogen-free 50-solar-mass model, evolved from an original main-sequence 120-solar-mass model, has a pulsationally unstable radial fundamental mode. All radial overtones are stable in this model, as is typical of massive He stars pulsationally driven by the epsilon effect at their centers. For the other four models, all with some residual surface hydrogen, no radial modes are unstable. Further, no unstable g-type nonradial modes are found for any of the five models. The nonradial modes have large amplitudes outside of the convective core, where they might be expected to be driven by the epsilon mechanism in their hydrogen-burning shells. However, their stability suggests that nonradial pulsations do not contribute to the extreme mass-loss rates observed for WR stars. Radial pulsations can occur for the hot He core burning (WNE, WC, and WO) WR stars, and could possibly cause mass loss, but only very late in their evolution. 22 references.

38238 **IRC + 10216 circumstellar envelope. I. Models for the dust and gas.** Keady, J.J.; Hall, D.N.B.; Ridgway, S.T. (Los Alamos National Lab., NM (USA); Hawaii Univ., Honolulu (USA); Kitt Peak National Observatory, Tucson, AZ (USA)). *Astrophysical Journal;* **326**: 832-842(Mar 1988).

Very high resoluton infrared spectra for the gas flow from the IRC + 10216 photosphere is interpreted using a detailed empirical model of the density, temperature, and velocity profiles of the gas. Amorphous carbon is shown to condense at about 3 stellar radii. Results give a mass-loss rate of 2 x 10 to the -5th solar masses/yr and suggest that most of the 2.3 micron CO absorption is produced by gas at distances greater than about 3 stellar radii. The CO column density into 3 stellar radii is found to be 2 x 10 to the 20th/sq cm, and the microturbulence in the region of 2-micron line formation is found to be about 1.0 km/s. 42 references.

38239 **IRC +10216 circumstellar envelope. II. Spatial measurements of the dust.** Ridgway, S.; Keady, J.J. (Kitt Peak National Observatory, Tucson, AZ (USA); Los Alamos National Lab., NM (USA)). *Astrophysical Journal;* **326**: 843-858(Mar 1988).

A detailed study has been performed of the spatial structure of the IRC +10216 dust shell in the wavelength range 1-5 microns. An occultation observed at 4.6 microns is deconvolved to provide a one-dimensional image. A radiometric analysis of the dust shell flux distribution is performed based on coeval photometry, leading to an estimate of the shell extinction, a decomposition of the flux into shell and stellar components, and an estimate of the temperature of the dust at the inner boundary of the shell. A simple, nonequilibrium, geometrical model of the shell is used to estimate the inner radius of the dust envelope, and detailed radiative equilibrium models based on realistic opacities and a two-component grain population are developed. The best estimates of model parameters are selected, and the limiting factors in the analysis are discussed. 18 references.

38240 **Directivity of 100 keV-1 MeV photon sources in solar flares.** Kane, S.R.; Fenimore, E.E.; Klebesadel, R.W.; Laros, J.G. (California Univ., Berkeley (USA); Los Alamos National Lab., NM (USA)). *Astrophysical Journal;* **326**: 1017-1031(Mar 1988).

Stereoscopic observations of 0.1-1.0 MeV photon sources in solar flares made with spectrometers aboard the ISEE 3 and PVO (Pioneer Venus Orbiter) have been analyzed to determine the directivity of the photon sources and its possible dependence on photon energy. During the period October 1, 1978-October 31, 1980, a total of 44 solar flares were observed simultaneously by the two instruments. Of these, 39 flares were in full view of both the instruments, the remaining five being partially occulted by the photosphere from the line of sight of at least one instrument. The view angles theta(P) and theta(I) of the PVO and ISEE 3 instruments with respect to the outward solar radius at the flare site varied from one flare to another and were in the range 9-88 deg. The difference between the two view angles varied from 1 deg to 66 deg. The observations of differential photon energy spectra averaged over more than about 16 s do not indicate any systematic directivity. In most flares the directivity of 0.1-1.0 MeV photon sources is found to be less than about 2.5. 34 references.

38241 **Cosmic string wakes and large-scale structure.** Charlton, J.C. (Chicago Univ., IL (USA); Cornell Univ., Ithaca, NY (USA)). *Astrophysical Journal;* **325**: 521-530(Feb 1988).

The formation of structure from infinite cosmic string wakes is modeled for a universe dominated by cold dark matter (CDM). Cross-sectional slices through the wake distribution tend to outline empty regions with diameters which are not inconsistent with the range of sizes of the voids in the CfA slice of the universe. The topology of the wake distribution is found to be spongy rather than cell-like. Correlations between CDM wakes do not extend much beyond a horizon length, so it is unlikely that CDM wakes are responsible for the correlations between clusters of galaxies. An estimate of the fraction of matter to accrete onto CDM wakes indicates that wakes could be more important in galaxy formation than previously anticipated. 42 references.

38242 **Model for the 1987 outburst of the recurrent nova U Scorpii.** Starrfield, S.; Sparks, W.M.; Shaviv, G. (Arizona State Univ., Tempe (USA); Los Alamos National Lab., NM (USA)). *Astrophysical Journal;* **325**: L35-L38(Feb 1988).

The paper presents simulations of the outburst of U Sco by accreting material, with a solar abundance of the CNO nuclei, at a rate of 1.1 x 10 to the -6th solar mass/yr onto a 1.35-solar mass white dwarf. This evolutionary sequence takes about 2.6 yr to reach runaway conditions and ultimately eject 4 x 10 to the -7th solar mass moving with speeds exceeding about 400 km/s. It is found that ejection occurred by radiation pressure rather than by explosive CNO burning. 22 references.

38243 **Interpretation of the gamma-ray bump from Cygnus X-1.** Liang, E.P.; Dermer, C.D. (Lawrence Livermore National Lab., CA (USA)). *Astrophysical Journal;* **325**: L39-L42(Feb 1988).

The strong 0.5-2 MeV gamma-ray bump of Cyg X-1 recently reported by HEAO 3 observers can be interpreted self-consistently as the emission from a hot (kT of about 400 keV) pair-dominated plasma. The emission region parameters are uniquely determined by the spectral fit and observed luminosity via the pair-balance condition, suggesting that the gamma rays are produced in the inner region of the accretion flow at the expense of the normal power-law hard X-rays. 27 references.

38244 **Positron annihilation in the Galactic center: "Cheshire cat" compton scattering and "excess continuum".** Bildsten, M.L.; Zurek, W.H. (Cornell University, Department of Physics. Ithaca, nY 14853). *AIP (American Institute of Physics) Conference Proceedings;* **155**: No. 1, 184-187(15 Apr 1987). (CONF-8610211—).

From Galactic Center conference; Berkeley, CA, USA (25 Oct 1986).

Two separate observations of the γ-ray spectrum originating from the Galactic Center were made by HEAO-3 in the fall of 1979 and in the spring of 1980. The 2γ 511 KeV annihilation line flux decreased by a factor of three over the corresponding six month period, whereas the excess γ-ray continuum below the 511 KeV line, often interpreted as 3γ decay of orthopositronium, barely changed. This apparent discrepancy in the temporal behavior makes it difficult to associate the bulk of the excess continuum with the 3γ decay of positronium. We will show that Compton scattering of the line and high energy radiation provides a natural explanation for the surprisingly small change seen in the excess continuum.

38245 **Origin of baryons in the Universe.** Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 1 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

One of the most fundamental questions in cosmology is the origin of the matter in the Universe. This talk will highlight recent developments in the theory of the origin of the nucleons in the framework of the big bang model. It will be shown that about 10^{-35} seconds after the bang conditions were present to generate an asymmetry between matter and antimatter. This small asymmetry provides the key for the survival of nucleons in the big bang. All the nuclei, atoms, and people present in the Universe today are a result of events in the first 10^{-35} seconds of the Universe.

38246 **Primordial nucleosynthesis in a universe with nonlinear inhomogeneities.** Matzner, R.A.; Centrella, J.M.; Rothman, T.; Wilson, J.R. (Univ. of Texas, Austin (USA)). pp 6 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

A completely relativistic, nonlinear plane-symmetric hydrodynamics and general relativity code is used to give the geometrical evolution within which they compute cosmic nucleosynthesis of light isotopes through ^{4}He. (Plane symmetry provides realistic modeling of the geometrical evolution during this epoch.) Local enhancement or depression of the element abundance may persist to the present. Average abundances found are not identical to the predictions of homogeneous cosmologies, and local abundances fluctuate in the range 22% - 27%. These inhomogeneous models are consistent with all observational constraints, in particular with the observed isotropy of the microwave radiation background.

38247 **Status of solar neutrino measurements.** Davis, R. Jr. (Univ. of Pennsylvania, Philadelphia (USA)). pp 7 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

A radiochemical neutrino detector was built by Brookhaven National Laboratory in 1965-1967 to observe the neutrino flux from the Sun and thereby test the thermal fusion theory of the solar energy. The experiment depends upon the neutrino capture reaction nu/sub e/ + ^{37}Cl → ^{37}Ar + e$^-$ that produces the 35 day radioisotope ^{37}Ar. The experiment uses 615 metric tons of C_2Cl_4 as a neutrino capturing medium. The detector is located 1480 meters below the surface to reduce background effects from cosmic radiation. The ^{37}Ar is removed from the liquid by a helium purge, purified and the ^{37}Ar activity is measured in a miniature proportional counter. Results will be reported on 68 individual measurements performed during the period 1970-1985. The results will be discussed in relation to theoretical models of the sun, current ideas in neutrino physics, and solar activity.

38248 **Probing the possibility of a ^{12}C/^{13}C abundance gradient from observations of interstellar CH$^+$.** Hawkins, I. (Lawrence Livermore National Lab., CA (USA)). pp 11 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The author has obtained the interstellar ^{12}C/^{13}C isotope ratio in the neighborhood of the Sun, from very high signal-to-noise optical observations of CH$^+$ toward the stars zeta Oph, zeta Per, P Cyg, 20 Tau, and 23 Tau. They have found that the ^{12}CH$^+$/^{13}CH$^+$ abundance ratios toward four different lines of sight are uniform within 12%. They provide evidence in favor of a locally-homogeneous ISM and have calculated a weighted mean ^{12}C/^{13}C ratio of 43 +/- 4. The similarity among the ^{12}CH$^+$/^{13}CH$^+$ ratios determined in four interstellar clouds possessing different physical conditions, precludes the possibility that fractionation or selective photodissociation of CH$^+$ are taking place in these regions. Thus the observed ^{12}CH$^+$/^{13}CH$^+$ isotope ratios are representative of the ^{12}C/^{13}C ratios in the gas. Since the CH$^+$ molecule seems to be the most sensitive probe of ^{12}C/^{13}C in the diffuse interstellar medium, they are obtaining CH$^+$ observations at CTIO and at Lick Observatory toward more distant stars located up to 2.5 kpc from the Sun to probe the existence of a Galactic ^{12}C/^{13}C abundance gradient. Observations of the stars HD 183143, HD24432, and HD157038 are presented.

38249 **US aspect of the Russian Ga-Ge experiment.** Bowles, T.J. (Los Alamos National Lab., NM (USA)). pp 12 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

A collaboration between the Academy of Sciences of the USSR and the University of Pennsylvania and Los Alamos National Laboratory has been formed to carry out at Ga-Ge solar neutrino experiment at the Baksan Neutrino Observatory in the Caucaus Mountains in Russia. The primary US involvement is to provide a complete counting system to detect the decay of single ^{71}Ge atoms which are produced by inverse beta decay from solar neutrinos in 60 tons of gallium metal. The progress towards accomplishing this detection capability and other aspects of the US involvement will be presented.

38250 **Molybdenum-technetium solar neutrino experiment.** Wolfsberg, K.; Schroeder, N.C.; Rokop, D.J.; Curtis, D.B.; Bryant, E.A.; Cowan, G.A.; Haxton, W.C. (Los Alamos National Lab., NM (USA)). pp 12 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

By measuring ^{98}Tc produced through the ^{98}Mo(nu,e$^-$) reaction in a deeply buried molybdenum deposit, they will measure the time-averaged ^{8}B solar-neutrino flux over about 10 Myr. Comparison with the Davis experiment will allow testing of the prediction of periodic mixing of the solar core over long time intervals. The experiment will also explore matter-enhanced neutrino oscillations; it is sensitive in unique portions of the δm^2-$\sin^2$theta plane. To separate technetium from 5000-ton quantities of Henderson-mine ore, they have taken advantage of the normal commercial mining, milling, and roasting operations of the AMAX Corporation. Technetium should volatilize during the conversion of molybdenite to molybdic oxide. They intercepted the scrub stream of the flue gases with ion-exchange columns to recover the technetium. After further purification, the technetium will be measured mass-spectrometrically by a very sensitive negative-thermal-ionization method. Details and preliminary results are presented.

38251 **Significance of neutrino oscillations.** Rosen, P. (Los Alamos National Lab., NM (USA)). pp 13 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The observation of neutrino oscillations would be a clear and unambiguous signal for the existence of neutrino mass. Solar neutrinos, because of their long baseline and low energies, provide the most sensitive probe for masses in the meV and sub-meV range. Recent developments concerning matter oscillations, and now known as the MSW effect (Mikheyev-Smirnov-Wolfenstein), lead to a new interpretation of the Davis experiment and to the need for measurements beyond those planned in the gallium experiments. This new scenario will be described, and its use as a tool to distin-

guish between solar models and neutrino properties as the cause of the Davis anomaly will be emphasized.

38252 **Nuclear reactions during cosmic ray transport.** Woo, L.W.; Kwiatkowski, K.; Viola, V.E.; Wilson, W.G.; Fatyga, M.; Fields, D.E.; Bonser, D.; Viola, R.W.; Mathews, G.J.; Breuer, H.; Mignerey, A.C. (Indiana Univ., Bloomington (USA)). pp 14 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

In order to investigate models of cosmic-ray origins, it is essential to understand the modification of the primary cosmic-ray source composition due to nuclear reactions which occur during transport through the interstellar medium. For this purpose excitation functions for all nuclides produced in reactions between the heavy-element component of the galactic cosmic rays and the primary interstellar medium elements, H and He, are required. Here they report results of mass, energy, and angular distributions for all fragments with $A > 4$ produced in reactions of ^{1}H and ^{4}He ions with ^{12}C, ^{16}O, and ^{28}Si at 50-200 MeV. Data were obtained at IUCF using fast-timing techniques in conjunction with conventional detector techniques. Results will be compared with predictions of precompound and intranuclear cascade calculations. Implications for galactic-cosmic-ray origins will be discussed.

38253 **Ubiquitous meteorite isotopic anomalies in Ca, Ti, and Cr.** Niemeyer, S. (Lawrence Livermore National Lab., CA (USA)). pp 15 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Discussions of isotopic anomalies usually focus on the several known FUN inclusions of Allende since most analyzed-elements in these samples show isotopic anomalies. In contrast, this review will consider only the anomalies which are commonly present in refractory Allende inclusions. Other than oxygen, such ubiquitous anomalies are presently resolved only in Ca, Ti, and Cr. The isotopic patterns in all 3 elements are consistent with a relative enrichment of the heaviest isotope. Smaller Ti anomalies are also found in whole-rock samples of most carbonaceous chondrites and in many of the chondrules from Allende, and in some chondrules from ordinary chondrites. The dominant anomalies at the neutron-rich isotopes indicate a single exotic component. The most likely source is neutron-rich hydrostatic burning at densities and temperatures found near the cores of massive stars. It is far from clear, though, how these nuclei are transported from the star through the ISM and then inhomogeneously distributed in solar system matter. Important factors are probably a refractory carrier phase for these neutron-rich isotopes and a chemical memory in the solar nebula whereby the dust component retains memories of its various nucleosynthetic origins and its subsequent history in the ISM.

38254 **Nucleosynthesis and supernovae produced by late time neutrino heating.** Mayle, R.W.; Wilson, J.R. (Univ. of California, Livermore (USA)). pp 22 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The composition of matter injected into the interstellar medium by supernovae is determined partly by the physics of the explosion and partly by the evolutionary history of the progenitor star. This talk will discuss the role of the explosion itself in determining elemental abundances of the ejecta, focusing on core collapse supernovae (typically associated with observational Type II events). In particular, the nucleosynthesis produced by progenitor stars with mass greater than 25 solar masses and exploding by the late time neutrino heating mechanism will be discussed.

38255 **Influences of the astrophysical environment on nuclear decay rates.** Norman, E.B. (Lawrence Berkeley Lab., CA (USA)). pp 28 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC03-76SF00098.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

In many astrophysical environments, physical conditions are so extreme that nuclear decay rates can be significantly altered from their laboratory values. At the high temperatures found in stellar interiors, nuclear excited states are populated and, in cases where the ground-state decay is highly forbidden, this can produce large increases in the nuclear decay rate. High-energy cosmic rays are fully stripped of their atomic electrons in passing through the interstellar medium. For the so-called electron-capture-only nuclei, this can result in dramatic decreases in the nuclear decay rate. Such effects are relevant to a number of current problems in nuclear astrophysics, including (1) the s-process neutron density inferred from the branch point at ^{148}Pm, (2) the nucleosynthesis of Nature's rarest isotope, ^{180}Ta, and (3) the cosmic-ray lifetimes of ^{54}Mn and ^{56}Ni. Laboratory experiments related to these problems are described.

38256 **Cosmological phase transitions.** Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 307-327 of Gravitation in astrophysics. Carter, B.; Hartle, J.B. (eds.). New York, NY; Plenum Publishing Corporation (1987). (CONF-8507172—).

From NATO advanced study institute on gravitational and astro physics; Cargese, France (15 Jul 1985).

If the universe stated from conditions of high temperature and density, there should have been a series of phase transitions associated with spontaneous symmetry breaking. The cosmological phase transitions could have observable consequences in the present Universe. Some of the consequences including the formation of topological defects and cosmological inflation are reviewed here. One of the most important tools in building particle physics models is the use of spontaneous symmetry breaking (SSB). The proposal that there are underlying symmetries of nature that are not manifest in the vacuum is a crucial link in the unification of forces. Of particular interest for cosmology is the expectation that are the high temperatures of the big bang symmetries broken today will be restored, and that there are phase transitions to the broken state. The possibility that topological defects will be produced in the transition is the subject of this section. The possibility that the Universe will undergo inflation in a phase transition will be the subject of the next section. Before discussing the creation of topological defects in the phase transition, some general aspects of high-temperature restoration of symmetry and the development of the phase transition will be reviewed. 29 references, 1 figure, 1 table.

38257 **Experimental determinations of reaction rates in the hot-CNO-cycle and the rp-process.** Parker, P.D. (Yale Univ., New Haven, CT (USA)). pp 32 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC02-76ER03074.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

In explosive nucleosynthetic events (e.g., the Hot-CNO-cycle and the rp-process), the temperatures and densities involved are sufficiently high so that proton and alpha-particle induced nuclear reactions can compete with beta decay. In order to study these reactions directly would require the use of short-lived radioactive targets or beams; however, it is possible to determine the relevant resonant reaction rates indirectly by making use of standard nuclear spectroscopy measurements together with stable nuclear targets and beams. Specific examples will be given in terms of recent measurements to determine the rates of the $^{13}N(p, \gamma)^{14}O$ and $^{15}O(\alpha, \gamma)^{19}Ne$ reactions.

38258 **Nuclear properties along the r-process path.** Aprahamian, A. (Lawrence Livermore National Lab., CA (USA)). pp 36-37 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

It has been pointed out that the description of r-process nucleosynthesis in a given astrophysical environment is strongly dependent on the input nuclear parameters. The nuclei produced are generally neutron-rich, far away from stability, and therefore not easily accessible by direct experimental observation. The required nuclear parametrization is often carried out by extrapolation from the known properties of nuclei near stability. The uncertainties introduced in this way have constituted some of the major limitations in the characterization of the r-process. Recently, however, it has been shown that totally different nuclear regions show a striking uniformity of behavior for certain observables as a function of the product of the number of valence protons and neutrons counted from the nearest closed shell. The main advantage of this approach is the conversion of the process of extrapolation of unknown nuclear properties to a far more reliable process of interpolation. The focus of this discussion will be the exploitation of this new approach to nuclear systematics to yield predictions for neutron-rich, rare-earth nuclei near the r-process abundance peaks at A=160 and 195.

38259 **Effects of recent improvements in mass formulae on the properties of neutron-rich heavy elements and implications for nuclear cosmochronology.** Howard, W.M.; Moeller, P.; Mathews, G.J.; Meyer, B.S. (Lawrence Livermore National Lab., CA (USA)). pp 37 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-7405-ENG-48.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Recent improvements in mass formulae used to calculate masses, ground state deformations and fission barriers have a dramatic influence on the calculated properties of neutron-rich heavy elements. In particular, the recent development of a mass formula based on a Yukawa-plus-exponential macroscopic model and a folded Yukawa microscopic model gives an improved prediction of the masses of neutron-rich nuclei. The improvement seems to be due to the inclusion of additional physical effects in the macroscopic energy, such as the finite range of the nuclear force. Also, a new finite-range droplet model combines the droplet model with the folding surface and Coulomb-energy integrals from the finite-range model, as well as a new term which depends on bulk density variations. They explore the results of these models on properties of neutron-rich heavy elements relevant to the astrophysical r-process.

38260 **Parameter study of the r-process.** Sale, K.E.; Mathews, G.J. (Lawrence Livermore National Lab., CA (USA)). pp 37 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-7405-ENG-48.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Observations of nearly pure r-process heavy element abundances in metal-poor halo stars suggest that the r-process occurs without pre-existing seed material, probably via the ejection of neutronized material from stellar cores or neutron star collisions. To better identify the possible site for such an r-process they have made a study of r-process nucleosynthesis as a function of the neutron mass fraction, total baryon density, and temperature describing the initial state of the r-process site. The calculations assume a rapid build-up of ^{56}Fe seed, adiabatic constant-velocity expansion, and include beta decay and fission energy release. A classical, dynamical r-process calculation follows the evolution of the composition until the neutrons are exhausted. They present the range of the parameters for which reasonable r-process yields can be obtained.

38261 **Shock ejection of hot neutron star matter as a site for the r-process.** Evans, C.R.; Mathews, G.J. (California Institute of Technology, Pasadena (USA)). pp 37 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The neutron stars in the binary pulsar PSR 1913 + 16 will coalesce in 3.5 x 10^8 years due to gravitational radiation reaction. During mergers of this type, a significant amount of material may be ejected from the system. Ejection is produced by shock acceleration and shock heating, followed by expansion acceleration of the heated material. A recent full two-dimensional treatment of a head on collision of such stars indicated a succession of shock waves produce a phase of steady mass ejection, during which as much as 5 to 10% of the material is expelled. In the more likely case of circular orbit decay, orbital motion will initial shocks in the common envelope which forms after tidal overflow. This highly neutronized material provides a favorable site for r-process during the subsequent decompression. This blow-off mechanism implies two main differences from previous work on the expansion and nucleosynthesis. The ejected material is initially hot, having been heated above 10^{10}K in the shocks and the escaping material comes to a terminal velocity, implying a high expansion rate. If the r-process is efficient during decompression, then a binary neutron star merger rate as low as 10^{-5} yr^{-1} can account for a significant fraction of galactic heavy element synthesis.

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38262 **(AD-A—190174/3/XAB) Support for FY87 midlatitude electron-density calibration campaign. Scientific Report No. 5, 4 June-15 October 1987.** Lansinger, J.M. (Northwest Research Associates, Inc., Bellevue, WA (USA)). 15 Oct 1987. 14p. (NWRA-CR—87-R018). NTIS, PC A03/MF A01.

One of the applications of data from AFGL's Auroral and Ionospheric Remote sensor (AIRS) aboard the Polar BEAR Satellite is an attempt to produce electron-density profiles from remote passive topside sensing. Development of this procedure required real-time acquisition of AIRS data simultaneously and closely colocated with data from the Millstone Hill incoherent-scatter radar. The field procedure to accomplish this objective involved utilization of the DNA Rover ground station deployed in the vicinity of Westford, MA to receive AIRS and other support data from P.BEAR while the satellite overflew the radar. The radar provided ground-truth information on ionospheric electron-density profiles and measurements of electron and ion temperature, plasma drift, and the thermospheric neutral wind during selected satellite passes between 1 July and 11 August, 1987. This report describes the field operations in support of the stated objective and some observations related to attitude determination for the Polar BEAR Satellite.

38263 **(AD-A—190466/3/XAB) Satellite uv image processing. Scientific report No. 4, 1 July-10 September 1987.** Rosenberg, N. (Northwest Research Associates, Inc., Bellevue, WA (USA)). 9 Oct 1987. 56p. (NWRA-CR—87-R016). NTIS, PC A04/MF A01.

The overall objective of the computer program is the photometric and geometric processing of UV satellite images. The data source is the AIRS scanning UV spectrometer aboard the POLAR BEAR satellite. The processing is designed to provide geographic-mapped images that describe the spatial and temporal variability of airglow and aurora of emitting species. The AIRS data stream provided simultaneous records from 3 detectors received at several ground stations from several passes per day. These total about 1500 useful images from launch to Feb. 1987. The major progress during the report period was development of programs to accomplish the following: 1) Statistical filtering of low-count images to provide meaningful brightness estimates; 2) Use of observed limb locations

to provide attitude correction in daylit images and attitude estimation in night images to provide accurate ground positions; 3) Normalization of airglow based on column path length and solar flux which allows separation of aurora from airglow portions of the images; 4) Multi-band presentation of auroral features that clearly define differences between the location of emitting species.

38264 **(AD-A—190469/7/XAB) Sudden ionospheric disturbance model uncertainty assessment. Final report, October 1984-September 1986.** Roy, T.N.; Sailors, D.B. (Naval Ocean Systems Center, San Diego, CA (USA)). Jul 1986. 35p. (NOSC/TR—1140). NTIS, PC A03/MF A01.

The impact of a sudden ionospheric disturbance (SID) on HF propagation is discussed. The development of an empirically derived relationship (SIDGRID) to model this impact is presented. The SIDGRID model compared to 198 observed sounder data points. For distances less than 1500 km, the short-range prediction error was 0.5 MHz and in 95% of the tests the long-range prediction error was less than or equal to 2.0 MHz. Current FORTRAN and BASIC implementations of the model are given in Appendices C and D.

38265 **(AD-A—190548/8/XAB) Instantaneous pictures of the high-latitude electrodynamics using Viking and DMSP/F7 observations.** Marklund, G.T.; Blomberg, L.G.; Hardy, D.A.; Rich, F.J. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Aug 1987. 7p. (AFGL-TR—87-0339). NTIS, PC A02/MF A01.

Pub. in Proceeding of the ESA Symposium on European Rocket and Balloon Programmes and Related Research (8th), 45-50(Aug 1987).

Simultaneous observations by the Viking and the DMSP/F7 satellites were applied to a new technique to obtain realistic pictures of the auroral electrodynamics. In particular, an instantaneous global equipotential pattern is calculated using field-aligned current and conductivity distributions that are qualitatively consistent with the Viking auroral imager data and quantitatively consistent with magnetic-field and particle data from the two satellites. This convection pattern agrees with the E x B-drift vectors estimated from Viking electric-field data. Discrepancies consistent with upward parallel electric fields occur in regions of upward currents. The pattern is of the normal two-cell type, with a small dusk cell and a large, elongated crescent-shaped dawn cell. The excellent agreement between the satellite and model data demonstrates the reliability of the results.

38266 **(PB—88-187877/XAB) STP (Solar-Terrestrial Physics) Newsletter 87-1.** (International Council of Scientific Unions, Urbana, IL (USA). Scientific Committee on Solar-Terrestrial Physics). 1987. 21p. NTIS, PC A03/MF A01.

Contents include: SCOSTEP organization; draft minutes of SCOSTEP Bureau meeting, August 20-21, 1987; solar-terrestrial energy program (STEP), preliminary report; USSR participation in STEP; STEP Steering Committee meeting, August 1987; CEDAR Steering Committee report; future meetings; and SCOSTEP adherents, secretaries and correspondents.

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REFER ALSO TO CITATION(S) 36986, 37033, 37104, 37111, 37481, 38208, 38660

38267 **(AD-A—190545/4/XAB) Parametric study on the quenching of critical velocity ionization.** Lai, S.; McNeil, W.; Murad, E. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 23 Sep 1987. 5p. (AFGL-TR—87-0335). NTIS, PC A02/MF A01.

Pub. in Conference on the Numerical Simulation of Plasmas (12th), 1-4(23 Sep 1987).

Numerical results on the quenching of critical ionization velocity (CIV) process due to pre-dissociation and dissociative electron-ion recombination are presented.

38268 **(CEA-CONF—9290) Reactive collision with excited states in a crossed beam experiment: $O(^1D) + H_2(v) \rightarrow OH(A\ ^2\Sigma^+) + H$.** Lebehot, A.; Marx, J.; Aguillon, F.; Drawin, S.; Campargue, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 4p. (CONF-870752—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753470/JAW.

From 11. international symposium on molecular beams; Edinburgh, UK (12 Jul 1987).

The $O(^1D)$ atomic beam is obtained from a radio frequency discharge nozzle jet source. The vibrational excitation, in the H_2 molecular beam, is produced by low energy electron bombardment. The reaction is observed through the spontaneous fluorescence of the product $OH(A^2\Sigma^+)$. The measured spectrum corresponding to the (0-0) $A\ ^2\Sigma^+ \rightarrow X^2\pi$ transitions is consistent with a simulated statistical rotational distribution of $OH(A^2\Sigma^+)$, i.e. the "prior" distribution of the information-theoretic approach. A strongly non-statistical effect on the spin distribution is observed: the $OH(A^2\Sigma^+)$ appears to be produced with only 13 of molecules in the -12 spin state.

38269 **(CONF-880435—8) Two-photon (VUV + visible) resonance ionization spectroscopy of molecular hydrogen.** McCann, M.P.; Chen, C.H.; Payne, M.G. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008365/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

Two-photon transitions have been examined in molecular hydrogen using coherent vacuum ultraviolet (VUV) photons at a fixed wavelength of 118 nm and a tunable photon from a dye laser. Though the VUV intensity is very weak ({approximately}100 nJ per pulse) it was utilized very efficiently since most VUV photons in the ionoization region were absorbed. This is the first time that coherent VUV light has been employed with tunable visible light for the production of two-photon spectra and the measurement of two-photon rates. A new parameter is proposed for direct comparison of the data from various two-photon experiments. 4 refs., 2 figs., 1 tab.

38270 **(CONF-880435—17) Suppression of multiphoton excitation in resonance ionization measurements.** Garrett, W.R.; Moore, M.A.; Wunderlich, R.K.; Payne, M.G. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009702/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

We describe experimental confirmation of strong suppressions of laser-driven nonlinear absorption processes by electromagnetic fields through other nonlinear processes within a given atomic or molecular medium. (AR)

38271 **(CONF-880706—1) Quantitative measurements of two-photon process of gases, liquids, and solids.** Chen, C.H.; McCann, M.P.; Payne, M.G. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88003094/JAW.

From International quantum electronics conference; Tokyo, Japan (18 Jul 1988).

Absolute two-photon absorption cross sections for various rare gas atoms and small molecules were measured by resonance ionization spectroscopy. Two-photon cross sections of various liquids and solids were obtained by the two-photon induced fluorescence method.

38272 (CONF-8610115—28) Comments on H^- volume production in Cs-seeded ion sources. Appendix I. Peterson, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AT03-80ER53091. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012119/JAW.

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Considerable interest was generated at the IAEA Negative Ion Beam Workshop in Grenoble, France, in March, 1985, by a report from the Kurchatov Institute on the development of a 2-ampere steady-state H^- ion source, in which the ions were volume-produced in a discharge in H_2, seeded with Cs vapor. The mechanism primarily responsible for this remarkably high current from a volume production source was not yet understood, but it was tentatively presumed to involve the collisional energy transfer from electronically excited Cs 6p atoms into H_2 vibrations. In any case, it was apparently different from the surface-plasma interactions that have been assumed to control the H^- production in the Dudnikov-Dimov type sources.

38273 (CONF-8707160—1) Alignment and orientation in ion{endash}atom collisions. Kimura, M.; Lane, N.F. (Argonne National Lab., IL (USA); Rice Univ., Houston, TX (USA)). 1987. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010015/JAW.

From International symposium on polarization and correlation in electronic and atomic collisions; Belfast, Ireland (20 Jul 1987).

Recent progress in the theoretical study of alignment and orientation in atom-atom and ion-atom collisions at intermediate energies is reviewed. Recent systematic studies of the alignment and orientation of electronic charge cloud distributions of excited states resulting from such collisions clearly have provided more detailed information about the underlying collision dynamics. However, since accurate determination of these parameters is quite difficult, both theoretically and experimentally, a close collaboration between theory and experiment is necessary for a deeper understanding of the collision dynamics. A more complete approach, where the full density matrix is determined, is also discussed.

38274 (DOE/ER—13700-1) Determination of stepsize parameters for intermolecular vibrational energy transfer: Progress report, May 1, 1987-April 30, 1988. Tardy, D.C. (Iowa Univ., Iowa City (USA)). May 1988. Contract FG02-87ER13700. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010904/JAW.

Intermolecular vibrational energy transfer for highly excited polyatomic molecules is involved in any mechanism in which excitation energy is required (pyrolysis) or in which energy must be removed from a hot source (cooling). The average energy removed per collision, <{DELTA}E>, is a useful quantity to compare efficiency for energy transfer. The objectives of this work are: to determine the dependence of <{DELTA}E> on excitation energy and on the molecular complexity (number of vibrational modes) of substrate and deactivator; to assess the importance of intermolecular attractions (complex formation) on vibrational energy transfer; to obtain detailed information on the energy distribution after collision and to evaluate the importance of <{DELTA}E> on high-temperature unimolecular reactions. This information will be obtained by monitoring the time dependence of the infrared emission, ultraviolet absorption, refractive index and pressure. The results from these complementary techniques will be benchmarked with <{DELTA}E> values from previous studies on the relaxation of chemically activated alkyl and fluoroalkyl radicals. Trajectory calculations simulating energy transfer are being performed for "generic" substrate/deactivator pairs to provide additional details and insight on the important parameters. Model calculations are also being performed to determine the feasibility of obtaining <{DELTA}E> information from experimental data for high-temperature unimolecular reactions.

38275 (DOE/ER/02887—1) Theoretical studies of highly ionized species: Final report for the period 1 March 1976 through 29 February 1988. Dalgarno, A. (Harvard Univ., Cambridge, MA (USA)). May 1988. Contract AC02-76ER02887. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011118/JAW.

Theoretical studies were carried out of atomic and molecular phenomena with an emphasis on the properties of highly-ionized systems. Methods were developed for the inclusion of correlation and relativistic effects in the determination of spectral line oscillator strengths and transition probabilities. The process of charge transfer by low energy multiply-charged ions colliding with atomic hydrogen was investigated and cross sections were obtained for many systems. It was pointed out that the favored channels often lead to excited ions which reveal their presence by specific emission lines. A multichannel theory of photodissociation was constructed that incorporates final state interactions. The properties of multiply-ionized molecules were explored and stable systems were identified. Work was carried out on intense field effects, the Berry phase in atomic physics and on processes of chemi-ionization. Plasma density effects on proton-impact excitations of fine-structure levels of hydrogenic ions were calculateed using a static potential model.

38276 (DOE/ER/13778—1) Correlated charge changing ion-atom collisions: Progress report for the period February 15, 1987-March 14, 1988. Bernstein, E.M.; Tanis, J.A. (Western Michigan Univ., Kalamazoo (USA)). Apr 1988. Contract FG02-87ER13778. 11p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009215/JAW.

This report summarizes the progress and accomplishments in accelerator atomic physics research supported by DOE grant DE-FG02-87ER13778 for a period of 13 months from February 15, 1987 through March 14, 1988. The general scope of this work involves the experimental investigation of fundamental atomic interactions in collisions of highly charged projectiles with neutral targets, with a particular emphasis on two-electron interactions. Inner-shell processes involving excitation, ionization, and charge transfer are investigated using coincidence techniques in which projectile charge-changing events are associated with x-ray emission, target recoil ions, or electron emission. New measurements were conducted using accelerators at the Lawrence Berkeley Laboratory, Argonne National Laboratory, Hahn-Meitner-Institut (Berlin), and Western Michigan University. The work at Hahn-Meitner resulted from a collaboration initiated while J. A. T. was on research leave from Western Michigan University during the 1986-1987 academic year. The principal new results obtained during the past year using each of the three coincidence techniques are summarized below. A major emphasis of all these investigations is to determine the role of electron correlation in two- (and multiple-) electron interactions.

38277 (DOE/ER/70068—T4) The kinetics of reactions of cyano compounds at high temperatures: Final report, February 1, 1985-January 31, 1988. Hanson, R.K.; Bowman, C.T. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). 1988. Contract AT03-76ER70068. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007997/JAW.

This report summarizes progress and accomplishments on a program to investigate the reaction kinetics of cyano compounds at high temperatures. During this program, research has proceeded in several areas, including: development of an atomic resonance absorption system (ARAS) for measuring H-atoms in shock tube kinetics experiments; measurement of the high-temperature rate coefficients of several reactions of cyano compounds in a shock tube using several different optical techniques, including ARAS and tunable laser absorption; and initial application of excimer laser photolysis for generation of the NCO radical for shock tube kinetics experiments. 10 refs., 3 figs.

38278 (GSI—87-11, pp A3.1-A3.3) Physical properties of heavy ion interactions with atoms and molecules. Toburen, L.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—). Contract AC06-76RL01830.

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

38279 **(IC—87/57) Inner-shell excitation of alkali-metal atoms.** Tiwary, S.N. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702041/JAW.

Inner-shell excitation of alkali-metal atoms, which leads to auto-ionization, is reviewed. The validity of quantum mechanical approximation is analyzed and the importance of exchange and correlation is demonstrated. Basic difficulties in making accurate calculations for inner-shell excitation process are discussed. Suggestions are made for further study of inner-shell process in atoms and ions. (author). 26 refs, 4 figs, 1 tab.

38280 (INIS-BR—1075, pp 10) **Location of electrons on liquid helium films.** Marques, G.E.; Studart, N. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38281 (INIS-BR—1075, pp 10) **Charge complexes in helium films.** Freitas, U. de; Studart, N.; Rino, J.P. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38282 (INIS-BR—1075, pp 12) **Genealogy of periodic orbits for non integrable hamiltonian system.** Malta, C.P.; Passos, E.J.V. de; Baranger, M.; Davies, C.T.R.; Aguiar, M.A.M. de. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38283 (INIS-BR—1075, pp 9) **Probability of adhesion to metallic surface.** Yoshida, M.; Oliveira, L.N. de. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38284 (INIS-mf—11219, pp 185-203) **Altered Thomas-Fermi model of the atom.** Brink, J.H.; Kok, F.J. (Pretoria Univ. (South Africa)). 1987. (In Afrikaans). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

The Thomas-Fermi theories are altered to calculate the ionization energies of atoms. At the same time we find that other atomic parameters such as average radius and binding energy, have improved quantitatively in respect to traditional theories.

38285 (INIS-SU—5/A, pp 24-28) **More accurate calculation of the energy levels of weakly bound rotation-vibrational states of mesic molecules ddμ and dtμ.** Vinitskij, S.I.; Korobov, V.I.; Puzynin, I.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780078/JAW. (JINR-N—3(23)-87).

In JINR rapid communications. Collection.

More accurate variational calculations are performed for energy levels is an element of$_{11}$ of weakly bound rotation-vibrational states (J=1 and V=1) of mesic molecules ddμ and dtμ. To this end, use has been made of a great number (up to 2000) of basis functions, a better distribution of powers of independent variables, more accurate values of nonlinear parameters, and of a more accurate value of the muon mass. The results of extrapolation are as follows: -is an element of$_{11}$(ddμ)=(1.9750+-0.0002) eV, -is an element of$_{11}$(dtμ)=(0.6604+-0.0002) eV. 4 refs.; 1 fig.; 3 tabs.

38286 **(JINR-E—17-87-194) Collective jumps in a system of three-level atoms.** Shumovskij, A.S.; Tanas, R.; Tran Quang. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702918/JAW.

Submitted to the journal Optics Comm. .

The collective jumps in the steady-state intensity of resonance fluorescence and the collective population trapping in a system of three-level atoms interacting with intense external field are considered. It is shown that for a proper choice of parameters the atomic populations and the steady-state intensity of resonance fluorescence from such a system display discontinuous behaviour (jumps) in a collective limit N -> ∞. Potential applications of collective jumps to measure weak transition linewidths are shortly discussed. 19 refs.; 3 figs.

38287 **(JINR-E—17-87-436) Collective resonance fluorescence in an intense laser field with phase and amplitude fluctuations.** Shumovskij, A.S.; Tanas, R.; Tran Quang. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702920/JAW.

Submitted to the journal J. Phys. .

The collective resonance fluorescence from a systen of two-level atoms resonantly driven by a strong laser field with the phase and amplitude fluctuations is considered. The effect of the field fluctuations on the spectrum as well as on the degrees of the second-order coherence of the fluorescent field is discussed in detail for the off-resonance case. 29 refs.; 5 figs.

38288 **(JINR-R—4-87-706) Energy levels of mesic molecules.** Vinitskij, S.I.; Puzynin, I.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702933/JAW.

Submitted to the journal J. Muon Catalysed Fusion.

A review is given for the methods and results of calculations of energy levels and wave functions of mesic molecules of hydrogen isotopes. The review includes the results since 1977 when characteristics of a weakly bound state (J=V=1) of mesic molecule dtμ were determined and reliably calculated, thus inspiring a renewed interest in the muon catalysis. Particular attention has been given to the construction of methods and high-precision calculations performed at the JINR. 33 refs.; 5 tabs.

38289 **(LA—11288-MS) Total and differential electron collision cross sections for O_2 and N_2.** Murphy, T. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 39p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010485/JAW.

We present a compilation of total and differential cross sections for electron scattering of N_2 and O_2. Energy-dependent total cross sections and energy- and angle-dependent differential cross sections are given for elastic, rotational, vibrational, electronic excitation, and ionizing collisions. 16 refs., 46 figs., 8 tabs.

38290 **(LA-UR—88-1446) Sources of polarized ions and atoms.** Cornelius, W.D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 22p. (CONF-880614—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010910/JAW.

From 7. international conference on ion implantation technology; Kyoto, Japan (7 Jun 1988).

In this presentation we discuss methods of producing large quantities of polarized atoms and ions (Stern-Gerlach separation, optical pumping, and spin-exchange) as well as experimental methods of measuring the degree of polarization of atomic systems. The usefulness of polarized atoms in probing the microscopic magnetic surface properties of materials will also be discussed. 39 refs., 5 figs., 2 tabs.

38291 (LA-UR—88-1671) Raman spectroscopy on simple molecular systems at very high density. Schiferl, D.; LeSar, R.S.; Moore, D.S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 27p. (CONF-880372—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010947/JAW.

From NATO advanced study institute on simple molecular systems at very high densities; Les Houches, France (29 Mar 1988).

We present an overview of how Raman spectroscopy is done on simple molecular substances at high pressures. Raman spectroscopy is one of the most powerful tools for studying these substances. It is often the quickest means to explore changes in crystal and molecular structures, changes in bond strength, and the formation of new chemical species. Raman measurements have been made at pressures up to 200 GPa (2 Mbar). Even more astonishing is the range of temperatures (4-5200{degree}K) achieved in various static and dynamic (shock-wave) pressure experiments. One point we particularly wish to emphasize is the need for a good theoretical understanding to properly interpret and use experimental results. This is particularly true at ultra-high pressures, where strong crystal field effects can be misinterpreted as incipient insulator-metal transitions. We have tried to point out apparatus, techniques, and results that we feel are particularly noteworthy. We have also included some of the {open<-quotes}oral tradition{close<-quotes} of high pressure Raman spectroscopy -- useful little things that rarely or never appear in print. Because this field is rapidly expanding, we discuss a number of exciting new techniques that have been informally communicated to us, especially those that seem to open new possibilities. 58 refs., 18 figs.

38292 (LBL—24068) Measurements of vacuum arc ion charge state distributions. Brown, I.G.; Galvin, J.E. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 9p. (CONF-880687—5). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008249/JAW.

From 13. international symposium on discharges and electrical insulation in vacuum; Paris, France (27 Jun 1988).

We have measured the charge state distribution of ions generated in the metal vapor vacuum arc under a wide range of experimental conditions. The experiments were carried out using an ion source in which the metal vapor vacuum arc is used as the method of plasma production and by which a high quality, high current beam of metal ions is produced. Charge state spectra were measured using a time-of-flight diagnostic; arc voltages were also measured. Parameters varied include: cathode material, arc current, axial magnetic field strength, neutral gas pressure, and arc geometry. 9 refs., 4 figs.

38293 (PUB—643) ALS handbook - a summary of the capabilities and characteristics of the advanced light source. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88011909/JAW.

This booklet aims to provide the prospective user of the Advanced Light Source with a concise description of the radiation a researcher might expect at his or her experimental station. The focus is therefore on the characteristics of the light that emerges from insertion devices and bending magnets and on how components of the beam lines further alter the properties of the radiation. The specifications and operating parameters of the ALS injection system and storage ring are of only peripheral interest. To this end, Sections 3 and 5 and most of Section 4 are devoted to summary presentations, by means of performance plots and tabular compilations, of radiation characteristics at the ALS - spectral brightness, flux, coherent power, resolution, time structure, etc. - assuming a representative set of four undulators and one wiggler and a corresponding set of five beam lines. As a complement to these performance summaries, Section 1 is a general introductory discussion of synchrotron radiation and the ALS, and Section 2 provides a compendious introduction to the characteristics of synchrotron radiation from bending magnets, wigglers, and undulators. In addition, Section 4 briefly introduces the theory of diffraction grating and crystal monochromators.

38294 (UCID—21077) Steady-state approximations in Raman excitation equations. Shore, B.W. (Lawrence Livermore National Lab., CA (USA)). 20 Dec 1987. Contract W-7405-ENG-48. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011759/JAW.

This memo presents equations describing propagation of beams of nearly monochromatic radiation through a Raman-active molecular vapor, under conditions of steady excitation of quantum-mechanical molecules by classical radiation (that is, by radiation that comprises a large number of photons per mode). Such conditions apply in the continuous-wave experiments that are conducted to measure such properties as Raman gain or Raman scattering cross sections. Under those circumstances the propagation is described by rate equations for molecular excitation and rate equations for photon numbers. Although these conditions do not apply for short-pulse transient excitation, both types of processes are parameterized by the same molecular polarizability matrix elements. This memo discusses those parameters, as extracted from steady state observations.

38295 Optical luminescence excitation spectra of molecular oxygen in the soft x-ray region. Yang, B.X.; Hanson, D.M.; Tohji, K. (State University of New York, Stony Brook, New York 11794). *Journal of Chemical Physics;* **89**: No. 3, 1215-1218(1 Aug 1988).

The observation of an anomaly in the optical luminescence excitation spectrum of oxygen in the region of the oxygen K edge is reported. Dispersed luminescence spectra were obtained for x-ray excitation at the pi and sigma resonances, at the anomaly, and in the continuum. These spectra indicate enhanced production of O/ sup 2+/$_2$ ions at both the sigma resonance and at the anomaly. The anomaly thus is attributed to a shake-up or shake-off state associated with an antibonding sigma molecular orbital of oxygen. This work also demonstrates that optical luminescence spectra provide state-specific information about the products of core hole excitation and relaxation.

38296 Absorption spectrum of the PuF_6 photodissociation product in the visible wavelength region. Kim, K.C.; Campbell, G.M. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **89**: No. 3, 1443-1444(1 Aug 1988).

We report the first spectroscopic observation of the transient photodissociation product following the 248 nm (KrF excimer laser) photolysis of PuF_6 and present its low resolution absorption spectrum in the visible. Although this photoproduct was postulated as the primary reaction intermediate for some time, up to now it has not been detected in the gas phase because of its extreme reactivity and instability.

38297 Crossed-beam reactive scattering of F_2 plus C_6H_6: Heat of formation of ipso-fluorocyclohexadienyl radical. Grover, J.R.; Wen, Y.; Lee, Y.T.; Shobatake, K. (Institute for Molecular Science, Myodaiji, Okazaki 444, Japan). *Journal of Chemical Physics;* **89**: No. 2, 938-946(15 Jul 1988).

Angular distributions and relative total cross sections were measured for products of the collisions of F_2 with C_6H_6 at relative collision energies of 14 to 26 kcal mol^{-1}. The most conspicuous product is the ipso-fluorocyclohexadienyl radical i-C_6H_6 Fts-dot, which displays a rather narrow peak very near the center-of-mass angle at all collision energies studied. Product C_6H_5F is masked at Me = 96 by dissociative ionization of C_6H_6 Fts-dot near the center-of-mass angle, but becomes observable at smaller angles to which little or no C_6H_6 Fts-dot is scattered. This means that at least one reaction $C_6H_6 + F_2 \rightarrow C_6H_5F + HF$ occurs, and does so in such a way that the products acquire high translational energies. The dependence on collision energy of the total cross section for the production of C_6H_6 Fts-dot was probably measured, and displays a well-marked onset at 13.9 +- 0.3 kcal mol^{-1}. The center-of-mass system means final state translational energy as a function of collision energy was obtained from the angular distributions and goes to zero at 13.9 +- 0.5 kcal mol^{-1}. This probably means that the onset is a true threshold, from which the heat of formation of the ipso-fluorocyclohexadienyl radical is calculated to be 14.8 +-

0.4 kcal mol^{-1}. The mean final state translational energy asymptotically approaches 3.7 kcal mol^{-1} as the collision energies are increased, which is so large that only a fraction of the vibrational modes of C_6H_6 Fts-dot can be involved in the energy partitioning.

38298 **Jellium-model calculation for dimer decays of potassium clusters.** Saito, S.; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **38**: No. 2, 1123-1130(15 Jul 1988).

We have calculated the total energies of n-atom potassium clusters K/sub n/ ($1 \leq n \leq 23$) using a jellium-sphere background model for the positive-ion cores and the local-spin-density-functional approximation for the valence electrons. We find that the K clusters which have exoergic fission channels have low abundances in the experimental mass spectra indicating the presence of thermal fissions of K/sub n/. Most of the exoergic fissions are found to produce dimers, K_2, as one of the daughter clusters. We have studied the "dimer decay" of K/sub 10/ in an attempt to explain why K/sub 10/ is one of the least abundant clusters in the K/sub n/ mass spectra. Two overlapping jellium spheres with constant density are used for the positive background. The energy-barrier height for complete decay from the energy-minimum point is found to be 0.18 eV, which is a reasonable magnitude for thermal decay compared to the experimental temperature. The monomer decay of K_6 and the dimer decay of K_8 are found to have higher barriers.

38299 **Si 2p and 2s resonant excitation and photoionization in SiF_4.** Ferrett, T.A.; Piancastelli, M.N.; Lindle, D.W.; Heimann, P.A.; Shirley, D.A. (Department of Chemistry, University of California, Berkeley, California 94720). *Physical Review [Section] A: General Physics;* **38**: No. 2, 701-710(15 Jul 1988).

We present partial-cross-section results for Si 2p and valence photoionization of SiF_4 for photon energies in the vicinity of the Si 2p and 2s thresholds. The continuum shape resonances decay only to the Si 2p main line, in accordance with one-electron theory predictions. The Si L/sub 2,3/VV Auger spectrum was also measured, and was found to agree with earlier work. We propose that variations in hole-interaction energies are important in assigning the Auger final states. For the Si 2p discrete excitations, spectra obtained on the σ/sup */(a_1) resonances compare well with previous qualitative results and the above-threshold Si L/sub 2,3/VV Auger spectrum. Our results help to quantify the relative enhancement of satellites and main lines, emphasizing the dominance of spectator decay. Spectra obtained at several higher-energy Si 2p and Si 2s excitations also generally support spectator decay as an important mode of relaxation for these discrete states. The overall assignment of the Si 2p and 2s discrete excitations to molecular-orbital and Rydberg transitions is discussed.

38300 **Time-dependent theory of multiphoton ionization of xenon.** Kulander, K.C. (Theoretical Atomic and Molecular Physics Group, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 2, 778-787(15 Jul 1988).

Calculations of the single and multiphoton ionization of xenon valence-shell electrons are reported for several wavelengths and laser intensities. The model follows a single valence electron in the field of an effective core potential, the remaining valence electrons, frozen in their ground-state orbitals, and a linearly polarized laser field. Ionization rates and cross sections are determined using a direct numerical solution of the time-dependent Schroedinger equation using a finite-difference technique. Excellent agreement with experimental rates and previous theoretical cross sections has been obtained. Bound states, shifted into resonance by the ac Stark effect, are found to affect the ionization dynamics. Departures from perturbation theory at high intensities are demonstrated and discussed.

38301 **Resonances in electron-impact single, double, and triple ionization of heavy metal ions.** Mueller, A.; Tinschert, K.; Hofmann, G.; Salzborn, E.; Dunn, G.H. (Institut fuer Kernphysik, Universitaet Giessen, D-6300, Giessen, Federal Republic of Germany). *Physical Review Letters;* **61**: No. 1, 70-73(4 Jul 1988).

We report narrow dielectronic capture resonances decaying by double autoionization observed for the first time in electron-impact ionization of ions. We also observe corresponding peaks in double and triple ionization leading us to postulate new processes where dielectronic capture is followed by triple or quadruple autoionization, respectively.

38302 **Vibrational branching ratios following two-color excitation of autoionizing np Rydberg states of H_2.** O'Halloran, M.A.; Dehmer, P.M.; Tomkins, F.S.; Pratt, S.T.; Dehmer, J.L. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **89**: No. 1, 75-84(1 Jul 1988).

Two-color resonantly enhanced multiphoton ionization-photoelectron spectroscopy (REMPI-PES) was used to determine vibrational branching ratios following autoionization of the ungerade $np\sigma\ ^1\Sigma^+$/sub u/ and $np\pi\ ^1\Pi$/sub u/ Rydberg states of H_2. In this two-step experiment, one laser used to excite the two photon transition to the $E,F\ ^1\Sigma^+$/sub g/, $v' = E2$, $J' = 1$ state, and a second laser was used to access the autoionizing Rydberg states near the $H^+{}_2X\ ^2\Sigma^+$/sub g/, $v^+ = 2$ ionization limit. Electrons corresponding to the formation of $H^+{}_2X\ ^2\Sigma^+$/sub g/, $v^+ = 0$ and 1 were collected and energy analyzed using a magnetic bottle electron spectrometer. In agreement with the well-known propensity rule for vibrational autoionization, the vibrational branching ratios strongly favor the final ionic state that corresponds to the minimum change in vibrational quantum number. In general, the branching ratio into the $v^+ = 1$ channel is 94%—96%, while that into the $v^+ = 0$ channel is 4%—6%; however, two major deviations from this trend were observed for Rydberg states that are perturbed by the $3p\pi\ ^1\Pi$/sub u/, $v = 9$ and $4p\sigma\ ^1\Sigma^+$/sub u/, $v = 7$ states.

38303 **Quasiclassical trajectory study of rotational energy transfer in the scattering of NH_3 from a flat, rigid gold surface.** Coltrin, M.E.; Kay, B.D. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **89**: No. 1, 551-561(1 Jul 1988).

Quasiclassical trajectories are used to study rotational energy transfer in the collision of a rigid-rotor NH_3 molecule with a flat, rigid gold surface. The anisotropic term in the long-range attractive potential causes the NH_3 to preferentially reorient with its dipole moment normal to the surface plane as it approaches the surface. This reorientation decreases the rotational energy transfer and gives rise to a sharp rotational rainbow at zero rotational energy. Trajectory results predict that the molecule preferentially scatters into low K states (tumbling) rather than the $J = K$ states (spinning). This prediction is in qualitative agreement with recent molecular beam/surface scattering experiments.

38304 **Multiconfiguration Hartree-Fock calculation of the photoionization of the excited Na 4d state.** Saha, H.P.; Pindzola, M.S.; Compton, R.N. (Department of Physics, University of Central Florida, Orlando, Florida 32816-0993). *Physical Review [Section] A: General Physics;* **38**: No. 1, 128-134(1 Jul 1988).

The photoionization cross section for the excited Na 4d state has been calculated with the multiconfiguration Hartree-Fock method. Ab initio methods are used to take into account the core-polarization effects. The minimum (zero) in the 4d→kp cross section has been calculated and it is found that including the effects of core-polarization shifts the position of the minimum (zero) to a higher energy. The calculation of the photoionization angular distribution asymmetry parameter is an excellent test to locate the minimum (zero) in the cross section. The present results are in good agreement with the experimental results of Smith et al. [Phys. Rev. A 22, 577 (1980)] performed at a single photon energy.

38305 **Photodetachment cross section of Cu^-.** Scheibner, K.F.; Hazi, A.U. (High Temperature Physics Division, Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 1, 539-542(1 Jul 1988).

We report the first ab initio calculation of the photodetachment cross section of the bound Cu^- ion. The calculated cross section exhibits two shape resonances, the larger of which should be

accessible experimentally. The magnitude of the cross section is substantial [(6.8—7.1) x 10/sup -17/ cm²] at wavelengths associated with the copper-vapor laser.

38306 Stark mixing of 2S muonic helium. I. Collisions with hydrogen atoms. Struensee, M.C.; Cohen, J.S. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 1, 44-52(1 Jul 1988).

The transitions between the 2S and 2P states of the muonic helium atom ($\alpha\mu$ or ^{3}He-μ) in collisions with hydrogen atoms are examined using the rectilinear-trajectory coupled-equation method. The 2S level shift is included semiempirically and the target atom is approximated using the frozen ground-state charge density. Partial decoupling of the coupled equations is achieved, and some simple approximations for the 2S-to-2P transition probability are derived and compared with the exact solution of the coupled equations. The cross section obtained is fit by $\sigma_{1/2}$/sub S//sub -/$_{3/2}$/sub P/≅5.5 x 10/sup -3// v/sup 1.8/a_0^2 for vapprox. >1, with the velocity v in atomic units, and muon-catalyzed fusion parameters are reevaluated using this expression.

38307 Stark mixing of 2S muonic helium. II. Molecular and multiple-scattering effects in hydrogen. Cohen, J.S.; Struensee, M.C. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 1, 53-57(1 Jul 1988).

The rectilinear-trajectory coupled-equation method is extended in this paper to collisions of $\alpha\mu$(2S) with molecular D_2. An efficient quadrature is formulated to integrate over the reaction probabilities and obtain the cross section that is dominated by trajectories passing close to one or the other nucleus. Molecular effects are found to increase the cross section by only 1—2 % above twice the atomic value. Coherent effects in multiple scattering by more than one molecule in a high-density (or condensed) medium are also examined and shown to be negligible.

38308 Cross sections for electron-impact single ionization of Kr/sup 8+/ and Xe/sup 8+/. Bannister, M.E.; Mueller, D.W.; Wang, L.J.; Pindzola, M.S.; Griffin, D.C.; Gregory, D.C. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6372). *Physical Review [Section] A: General Physics;* **38**: No. 1, 38-43(1 Jul 1988).

Absolute cross sections for electron-impact single ionization of Kr/sup 8+/ and Xe/sup 8+/ ions were measured for energies below the ionization thresholds to 1500 eV using the crossed-beams method. A significant fraction of the Kr/sup 8+/ and Xe/sup 8+/ ion beams were in metastable configurations. Configuration-average distorted-wave calculations for ions in the ground and first-excited configurations are compared to the experimental data. For both ions in this study, the excitation-autoionization contribution to the total ionization cross section is found to be much larger for ions in the first-excited configuration, which includes metastable levels, than for the ground-state ions. Maxwellian rate coefficients were calculated for Kr/sup 8+/ and are compared to published results.

38309 Extended low-frequency approximation for laser-modified electron scattering: Coulomb effects. Mittleman, M.H. (High Temperature Physics Division, Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 1, 82-92(1 Jul 1988).

The Kroll-Watson [N.M. Kroll and K. M. Watson, Phys. Rev. A 8, 804 (1973)] theory for electron scattering in the field of a low-frequency laser has been extended by L. Rosenberg [Phys. Rev. A 23, 2283 (1981); 28, 2727 (1983)] to apply to higher intensities. That result is rederived in another way so as to make the correction second order. The correction terms are obtained and shown to be small in the high-intensity low-energy regime in which the original theory is weakest. The special case of a Coulomb potential is analyzed and shown to present special peculiarities in the extended theory just as in the original Kroll-Watson theory.

38310 Comment on "The strange polarization of the classical atom" [Am. J. Phys. 55, 906 (1987)]. Biedenharn, L.C.; Brown, L.S.; Solem, J.C. (Department of Physics, Duke University, Durham, North Carolina 27706). *American Journal of Physics;* **56**: No. 7, 661-663(Jul 1988).

There has been much interest recently, both experimentally and theoretically, in "Rydberg atoms": atoms with large principal quantum number n. A classical treatment of the associated Coulomb field problem describes most of the features of these atoms. Using classical mechanics, Solem[1] recently showed the existence of an interesting, counterintuitive effect for an atom in a weak uniform electric field: The response of the electron was orthogonal to the direction of the applied field. This effect was shown both analytically by the method of variation of parameters and numerically by direct integration of the equations of motion. Such a basic effect in a simple system should, however, admit an elementary derivation. This we provide here.

38311 Electron-impact ionization cross sections for the xenon isoelectronic sequence. Younger, S.M. (A-Division, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **37**: No. 11, 4125-4132(1 Jun 1988).

Cross sections are presented for the direct electron-impact ionization of the 5p, 5s, and 4d subshells of the ground state of the first six members of the xenon isoelectronic sequence. The calculations were performed in a distorted-wave Born-exchange approximation including the effects of term-dependent partial waves in the ejected-electron channel and ground-state electron correlation. Shape resonances were found to significantly enhance the cross sections at low incident electron energies for Xe, Cs^+, and Ba^{2+}. Term dependence in the $5p^5kd$ and $4d^9kf$ ejected-electron channels was also significant for these ions. Ground-state correlation was somewhat less influential, and affected the cross section only when ejected-electron term dependence was also significant.

38312 Fifth-harmonic production in neon and argon with picosecond 248-nm radiation. Rosman, R.; Gibson, G.; Boyer, K.; Jara, H.; S. T. Luk; McIntyre, I.A.; McPherson, A.; Solem, J.C.; Rhodes, C.K. (Laboratory for Atomic, Molecular, and Radiation Physics, Department of Physics, University of Illinois at Chicago, P.O. Box 4348, Chicago, Illinois 60680). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 6, 1237-1242(Jun 1988).

The results of a study of fifth-harmonic production in neon and argon irradiated with 248-nm picosecond laser pulses are presented. Focused intensities range from 10^{13} to 10^{15} Wcm^2. Data for fifth-harmonic intensity as a function of both target density and focused laser intensity are presented and compared with theory. For the laser intensities and medium densities studied, estimates for the linear and nonlinear components of Δk, the wave-vector mismatch between the fundamental and harmonic waves, indicate that the nonlinear component is much greater than the linear component.

38313 Spectra of copperlike and zinclike xenon: Xe XXV and Xe XXVI. Kaufman, V.; Sugar, J.; Rowan, W.L. (Atomic and Plasma Radiation Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 6, 1273-1274(Jun 1988).

The spectra of highly ionized xenon were generated in a tokamak plasma and photographed in the region 60—350 A with a 2.2-m grazing-incidence spectrograph. The $4s^2$—4s4p transitions of Zn-like xenon (Xe XXV) and all the 4l—4(l+1) transitions of Cu-like xenon (Xe XXVI) were measured with estimated uncertainties of +- 0.005 A. These measurements have been combined with previous wavelength measurements of Xe XXVI to determine energy levels. A value for the ionization energy of Xe^{25+} of 6 912 400 +- 3000 cm^{-1} (857.0 +- 0.4 eV) was derived.

38314 **A comparison of experiment, CEPXS/ONETRAN, TIGERP, and TIGER net electron emission coefficients for various bremsstrahlung spectra.** Ballard, W.P.; Lorence, L.J. Jr.; Snowden, D.P.; Van Lint, V.A.J.; Beale, E.S. (Sandia National Labs., Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 6, 1569-1574(Dec 1987). (CONF-8707112—). Contract AC04-76DP00789.

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

This work compares a carefully designed experiment to measure photoemission with the predictions of three different codes (CEPXS/ONETRAN, TIGERP, and TIGER) for the complex bremsstrahlung spectra typical of very intense pulsed power x-ray generators. The Monte Carlo codes TIGER and TIGERP can calculate the net photon-induced electron emission but accurate results may require that statistical error be minimized. CEPXS/ONETRAN is a new deterministic coupled electron/photon transport code that is faster than Monte Carlo and is not subject to statistical error. The comparison of net yields is a sensitive test of the relative accuracy and efficiency of these various codes. The authors find that all of the codes substantially agree with the experiments for the forward net yields. However, for reverse net yields from high-Z materials, the codes overpredict relative to measurements.

38315 **Rotationally and vibrationally inelastic collisions of NH_3 with Au(111): Experiment and theory.** Kay, B.D.; Coltrin, M.E.; Raymond, T.D. (Sandia National Labs., Albuquerque, NM 87185 (US)). pp 98 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper WCC 2.

The authors measured angular, velocity, and quantumstate distributions for ammonia molecules scattered from a gold (111) single crystal for a number of surface temperatures and incident beam energies. To explain the experimental observations, the authors developed a classical trajectory code for scattering of a rigid nonlinear molecule from a rigid flat gold surface. The authors' classical trajectory calculations predict the propensity for tumbling vs spinning seen experimentally. The distribution of scattered molecules is markedly non-Boltzmann with low-K states preferentially populated. The authors extended their classical trajectory model to include the umbrella vibrational motion in NH_3. The model predicts very efficient transfer of translational energy to the umbrella vibrational mode. The vibrational excitation is predicted to scale with the normal component of incident kinetic energy in agreement with the experimental observation.

38316 **Observation of collision-induced coherence and ground-state spin gratings in a flame.** Rahn, L.A.; Trebino, R. (Sandia National Labs., Combustion Research Facility, Livermore, CA 94550 (US)). pp 70 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper TUGG 43.

In four-wave mixing and induced-grating processes, collisions can dephase quantum-mechanical amplitudes that would otherwise destructively interfere. As a result, otherwise forbidden extra resonances occur in these nonlinear optical processes having strengths that increase with pressure. In particular, Raman-type processes have, in addition to the well-known term proportional to the population difference, rho$_{11}$/sup (O)/ - rho$_{22}$/sup (O)/, an additional collision-induced term/sup 2,3/ proportional to rho$_{11}$/sup (O)/ + rho$_{22}$/sup (O)/. Thus collisions can induce a Raman-type resonance between equally populated levels. In addition, collisions can cause population gratings to occur in nonresonant pumping conditions. In this process, it is the distortion introduced in the energy level structure of the atom or molecule by collisions that allows the necessary population transfer to occur. Previous experimental work has demonstrated these and other collision-induced effects in sodium in the presence of various buffer gases. The authors extend these measurements to a flame environment, where collision-sensitive processes are of great interest. In addition, the authors observe several new characteristics of collision-induced phenomena.

38317 **Sum frequency generation for surface vibrational spectroscopy.** Hunt, J.H.; Guyot-Sionnest, P.; Shen, Y.R. (UC-Berkeley, Center for Advanced Materials, Lawrence Berkeley Lab., Berkeley, CA 94720 (US)). pp 108 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper WGG 1.

Surface vibrational spectroscopy is one of the best means for characterizing molecular adsorbates. For this reason, many techniques have been developed in the past. However, most of them suffer from poor sensitivity, low spectral and temporal resolution, and applications limited to vacuum solid interfaces. Recently, the second harmonic generation (SHG) technique was proved repeatedly to be a simple but versatile surface probe. It is highly sensitive and surface specific; it is also capable of achieving high temporal, spatial, and spectral resolution. Being an optical technique, it can be applied to any interface accessible by light. The only serious drawback is its lack of molecular selectivity. An obvious remedy is the extension of the technique to IR-visible sum frequency generation (SFG). Surface vibrational spectroscopy with submonolayer sensitivity is then possible using SFG with the help of a tunable IR laser. The authors report here an SFG measurement of the C-H stretch vibration of monolayers of molecules at air-solid and air-liquid interfaces.

38318 **Radiative capture processes in hot plasmas.** Hahn, Y. (Univ. of Connecticut, Storrs (USA)). pp 23-74 of Atomic processes in electron-ion and ion-ion collisions. Brouillard, F. (ed.). New York, NY; Plenum Publishing Corporation (1986). (CONF-8509196—).

From NATO advanced study institute on physics of electron-ion and ion-ion collisions; Han sur Lesse, Belgium (30 Sep 1985).

The theory of electron capture by ionic targets is discussed and a calculational procedure for the evaluation of capture rates and cross sections is outlined. Scaling properties of the radiative and Auger transition probabilities are examined in detail. Sample calculations of dielectronic recombination (DR) rates and cross sections are given. Refinements for the basic calculation which are described. These include configuration interaction, intermediate coupling, orders of coupling, overlapping resonances, cascade effects, and the fine-structure effect. The effect of extrinsic electric fields on the DR cross section is considered and atomic process related to DR are summarized. Field-induced l-mixing, field mapping of the captured states, field ionization, and possible field-induced shifts of the captured high Rydberg states by time-dependent electric fields are all considered. 55 references, 24 figures, 4 tables.

38319 **Electron-ion collisions in the average-configuration distorted-wave approximation.** Pindzola, M.S.; Griffin, D.C.; Bottcher, C. (Oak Ridge National Lab., TN (USA)). pp 75-91 of Atomic processes in electron-ion and ion-ion collisions. Brouillard, F. (ed.). New York, NY; Plenum Publishing Corporation (1986). (CONF-8509196—). Contract AC05-84OR21400.

From NATO advanced study institute on physics of electron-ion and ion-ion collisions; Han sur Lesse, Belgium (30 Sep 1985).

Explicit expressions for the electron-impact excitation, ionization, and resonant-recombination cross sections are derived and numerical results are calculated in the distorted-wave approximation. Calculations using these expressions are applied to several types of phenomena in electron-ion scattering where comparison with other theoretical methods and experimental measurements can be made. 24 references, 5 figures.

38320 Experiments on electron-impact excitation and ionization of ions. Phaneuf, R.A. (Oak Ridge National Lab., TN (USA)). pp 117-156 of Atomic processes in electron-ion and ion-ion collisions. Brouillard, F. (ed.). New York, NY; Plenum Publishing Corporation (1986). (CONF-8509196—). Contract AC05-84OR21400.

From NATO advanced study institute on physics of electron-ion and ion-ion collisions; Han sur Lesse, Belgium (30 Sep 1985).

The quantitative study of inelastic collisions between electrons and ions has been motivated for many years by the astrophysical community. The need for accurate collision cross sections has been dramatically intensified during the last decade by the worldwide emphasis on controlled-thermonuclear-fusion research, and its development as a potential energy source. The energetic radiation from highly ionized impurities in such high-temperature plasmas represents a serious mode of energy loss which has thus far prevented such devices from reaching the required ignition temperature and confinement condition. The effect of impurity ions on plasma confinement is also poorly understood, and may perhaps even be beneficial under certain circumstances. Accurate models for plasmas require reliable cross section data for electron-impact excitation, ionization and recombination of these impurity ions. The present report will review some of the fundamental aspects and then focus on highlighting some of the important experimental results which have been produced during the interim period. 82 references, 24 figures, 1 table.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 38326

38321 (AD-A—189940/0/XAB) MPD (magnetoplasmadynamic) thrust-chamber flow dynamics. Annual report, 1 October 1986-30 September 1987. (R and D Associates, Alexandria, VA (USA)). 29 Sep 1987. 60p. (RDA-TR—144200). NTIS, PC A04/MF A01.

Performance characteristics of Magnetoplasmadynamic(MPD) arcjets depend on proper matching of electromagnetic and fluid-mechanical constraints within the thrust chamber. Experimental measurements of internal-flow conditions during MPD arcjet operation are needed to guide developement of flow models and to assess the validity of theoretical predictions. Efforts are continuing in a corporative effort to apply an array of diagnostic techniques including time-, space-, and spectrally-resolved photography to examine MPD arcjet internal flows. Experimental elucidation of the internal flow structure is used to develop predictive models for optimal geometries and operating parameters. Probes have been used to map the current and voltage distributions within uniform height and flared annular channels. This work is concerned with the effect of thruster channel variations on the current conduction regions of the MPD internal flow. Other aspects of the internal flow structure that were modeled involve the transition of the input mass flow from neutral gas to electrically-conducting plasma. Scale sizes for the transition region were estimated in terms of the electrical and thermodynamic properties of the propellant gas (e.g., argon). These estimates indicate that the electrical conductivity of the flow can be established in distances that are small compared to the characteristic dimension for current conduction near the entrance to the arcjet thrust chamber.

38322 (AD-A—190295/6/XAB) Rail damage in a solid-armature rail gun. Final report. Brassard, T.; Homan, C.G. (Army Armament Research and Development Command, Watervliet, NY (USA). Benet Weapons Lab.). Dec 1987. 22p. (ARCCB-TR—87035). NTIS, PC A03/MF A01.

Plasma-arc-drive rail guns operate by forming a high-temperature plasma behind the projectile using a thin metal fuze. These systems achieve the highest projectile velocities (about 12 km /sec), since the driving force includes a substantial plasma pressure as well as the electromagnetic or Lorentz force. Unfortunately, severe rail damage occurs primarily from the intense temperatures generated by the plasma arc and the wiping motion of the armature itself. The solid-armature gun replaces the plasma armature with a conducting metal armature. Since the plasma arcing is reduced or eliminated, the projectiles are accelerated mainly by the Lorentz force. Thus, solid armature rail guns operate at lower projectile velocities. The important tradeoff is that there is a substantial reduction in rail damage for metal armature projectiles. The elimination of the plasma force limits projectile velocities in the metal-armature rail guns. A more-subtle limit is the speed at which the commutation process can take place. Although the latter limit is still not well understood, experimental evidence indicates a commutation limit may occur near 6 to 7 km/sec. This velocity limit is still attractive for Army tactical missions for rail guns. The actual rail damage occurring with two types of metal armatures, wire brush contactors and monolithic metal contactors, and new developments in barrel technology, such as superconducting augmentation, are presented in this report.

38323 (AD-A—190310/3/XAB) Plasma-gas interaction studies in a hybrid-plume plasma rocket. Annual report, 1 September 1986-30 August 1987. Chang-Diaz, F.R.; Yang, T.F. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 30 Sep 1987. 31p. NTIS, PC A03/MF A01.

This report discusses the progress in the fluid modeling of a hybrid-plume plasma rocket and the heating of plasma in a tandem-mirror device. In the theoretical area, three tasks were accomplished: 1) a major advance has been made in the development of a numerical method for solving the time-dependent fluid equations for both ions and electrons in the plasma; 2) a mathematical model was formulated for studying the radio-frequency heating of the hot plasma in cylindrical geometry; and 3) an analysis on the performance characteristics of the hybrid plume rocket was carried out. Under funding of the instrumentation program, component fabrication is in progress. The coils have been delivered.

38324 (BUM—84) Linear waves and stability in ideal magnetohydrodynamics. Eckhoff, K.S. (Bergen Univ. (Norway). Dept. of Applied Mathematics). May 1987. 70p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752487/JAW.

Linear waves superimposed on an arbitrary basic state in ideal magnetohydrodynamics are studied by an asymptotic expansion valid for short wavelenghts. The theory allows for a gravitational potential, and it may therefore be applied both in astrophysics and in problems related to thermonuclear fusion. The linearized equations for the perturbations of the basic state are found in the form of a symmetric hyperbolic system. This symmetric hyperbolic system is shown to possess characteristics of nonuniform multiplicity, which implies that waves of different types may interact. In particular it is shown that the mass waves, the Alf-n waves, and the slow magnetoacoustic waves will persistently interact in the exceptional case where the local wave number vector is perpendicular to the magnetic field. The equations describing this interaction are found in the form of a weakly coupled hyperbolic system. This weakly coupled hyperbloc system is studied in a number of special cases, and detailed analytic results are obtained for some such cases. The results show that the interaction of the waves may be one of the major causes of instability of the basic state. It seems beyond doubt that the interacting waves contain the physically relevant parts of the waves, which often are referred to as ballooning modes, including Suydam modes and Mercier modes. 19 refs.

38325 (CONF-8804124—2) Solidification with natural circulation. Domanus, H.M.; Sha, W.T. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 19p. (CONF-8804124—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011197/JAW.

From Modeling control of casting and welding processes conference; Palm Coast, FL, USA (17 Apr 1988).

The solidification of a superheated liquid gives rise to buoyancy forces which cause motion of the remaining liquid, or natural circulation. The natural circulation can affect the rate of solidification as well as the shape of the solidified mass. This paper presents a numerical model to solve a set of conservation of mass momentum, and energy equations as a boundary value problem in space and an initial-value problem in time. This model is employed to predict the evolution of the coupled heat transfer and fluid flow characteristics in a solidifying superheated liquid. The results obtained from this model for a plane solidification system have been

compared with the usual pure-conduction solution as well as some available experimental measurements. 11 refs., 10 figs.

38326 **(DOE/ER/25035—1) Piecewise-parabolic methods for systems of hyperbolic conservation laws in multiprocessing environments: Progress report.** Woodward, P.R. (Minnesota Univ., Minneapolis (USA). Supercomputer Inst.). Apr 1988. Contract FG02-87ER25035. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010202/JAW.

This paper discusses the use of piecewise-parabolic methods to solve hydrodynamic and magnetohydrodynamic models on multiprocessing computers. (LSP)

38327 **(INIS-BR—1018, pp 34) Electronic states located at the surface of liquid helium films: a self consistent treatment.** Marques, G.E.; Studart, N. (Sao Carlos Univ. (Brazil). Dept. de Fisica; Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38328 **(SAND—88-0057C) Experimental measurements of pressure in water-entry cavities.** Wolfe, W.P.; Gutierrez, W.T. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880740—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007209/JAW.

From Cavitation and multiphase forum; Cincinnati, OH, USA (24 Jul 1988).

In order to expand the water-entry cavities data base to higher entry speeds and oblique angles and to obtain data for the time from minimum cavity pressure to cavity collapse, a water-entry test was performed in August, 1987, at the Naval Surface Warfare Center's (NSWC) Hydroballistics Facility in White Oak, Maryland. This paper presents the preliminary analysis of the data from that test. 6 refs., 7 figs.

38329 **(SAND—88-0067C) Forces and moments on a slender, cavitating body.** Hailey, C.E.; Clark, E.L.; Buffington, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880740—3). NTIS, PC A02;3. Order Number DE88007208/JAW.

From Cavitation and multiphase forum; Cincinnati, OH, USA (24 Jul 1988).

Recently a numerical code has been developed at Sandia National Laboratories to predict the pitching moment, normal force, and axial force of a slender, supercavitating shape. The potential flow about the body and cavity is calculated using an axial distribution of source/sink elements. The cavity surface is assumed to be a constant pressure streamline, extending beyond the base of the model. Slender body approximation is used to model the crosaflow for small angles of attack. A significant extension of previous work in cavitation flow is the inclusion of laminar and turbulent boundary layer solutions on the body. Predictions with this code, for axial force at zero angle of attack, show good agreement with experiments. There are virtually no published data availble with which to benchmark the pitching moment and normal force predictions. An experiment was designed to measure forces and moments on a supercavitation shape. The primary reason for the test was to obtain much needed data to benchmark the hydrodynamic force and moment predictions. Since the numerical prediction is for super cavitating shapes at very small cavitation numbers, the experiment was designed to be a ventilated cavity test. This paper describes the experimental procedure used to measure the pitching moment, axial and normal forces, and base pressure on a slender body with a ventilated cavity. Limited results are presented for pitching moment and normal force. 5 refs., 7 figs.

38330 **(SAND—88-1110C) Cavitation inception in a turbulent shear flow.** O'Hern, T.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 34p. (CONF-880716—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011486/JAW.

From 1. national fluid dynamics congress; Cincinnati, OH, USA (24 Jul 1988).

Experimental investigations were made into the inception processes in a large turbulent free shear layer generated by a sharp edged plate in a water tunnel at Reynolds numbers up to 2 {times} 10^6. Optical techniques were used to study the relation of cavitation inception to flow characteristics, in particular to the coherent vortices of the free shear layer turbulent structure. Two distinct types of vortex motion were evident, primary spanwise and secondary longitudinal vortices. Cavitation inception consistently occurs in the secondary shear layer vortices and more fully developed cavitation is visible in both structures, with the streamwise cavities typically confined to the braid regions between adjacent spanwise vortices. Measurements of fluctuating pressures in the turbulent shear layer were made by holographically monitoring the size of air bubbles injected into the non-cavitating flow, showing that pressure fluctuations were much stronger than previously reported, with positive and negative pressure peaks as high as 3 times the freestream dynamic pressure, sufficient to explain the occurrence of cavitation inception at high values of the inception index. The occurrence of inception in the secondary vortices of the shear layer, and previous reports of velocity dependence of these cores, may provide the key to explaining the commonly observed Reynolds number scaling of the inception index in shear flows. 20 refs., 9 figs., 1 tab.

38331 **(UCRL—98678) A study of the vortex sheet method for solving the Prandtl boundary layer equations.** Puckett, E.G. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48;AC03-76SF00098. 10p. (CONF-8709292—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011346/JAW.

From 7. Gesellschaft fur Angewandte Mathematik und Mechanik conference on numerical methods; Louvain-la-Neuve, Belgium (9 Sep 1987).

The vortex sheet method for solving the Prandtl boundary layer equations is the most widely used means of satisfying the no-slip boundary condition in a random vortex method solution of the Navier-Stokes equations. It is a fractional step method in which random walks are used to solve the diffusion equation and particles, called 'sheets', are created at the boundary in order to satisfy the no-slip boundary condition. A review of those theoretical results currently known is presented including the consistency of the random walk/sheet creation process. The convergence of the method to Blasius flow is then demonstrated numerically and from the data presented rates of convergence in terms of the computational parameters are conjectured. 26 refs., 1 fig., 4 tabs.

38332 **Detection of radio-frequency signals emitted by an arc discharge.** Damas, M.C.; Robiscoe, R.T. (Physics Department, Montana State University, Bozeman, Montana 59717). *Journal of Applied Physics;* **64**: No. 2, 566-574(15 Jul 1988).

We analyze the nature of radiation signals detected from electrical arcing events originating on highly charged dielectric surfaces. Starting from a simple model of the arc current pulse, we calculate the electromagnetic radiation signal incident on a distant radio-frequency receiver. The receiver is tuned to some central frequency and operates in a given bandwidth. Because the receiver responds to the arc current derivative rather than the arc current itself, the detected radiation pulse profile can differ substantially from the current pulse profile, even when the receiver bandwidth is large compared to the reciprocal pulse width. This signal distortion significantly affects the interpretation of arc radiation data. To illustrate the point, we show that at high frequencies the detected pulse width carries very little information on the arc itself, and that even a scan of pulse width versus frequency may provide a misleading picture of possible arc dynamics. Finally, we argue that arc radiation data from radio-frequency measurements are most useful at low frequencies, when the receiver frequency and bandwidth are both comparable to the reciprocal arc duration.

38333 **Color-induced transition to a nonconventional diffusion regime.** Tsironis, G.P.; Grigolini, P. (University of California at San Diego, La Jolla, California 92093). *Physical Review Letters;* **61**: No. 1, 7-10(4 Jul 1988).

It is shown that the negative diffusion coefficients exhibited by the current approaches to the Fokker-Planck equation for non-Markovian and bistable processes result from assuming the diffusion

process to be stationary. The rejection of this assumption leads to predictions on the escape over a barrier agreeing with the physical arguments pertaining to the extremely colored-noise regime.

38334 **Lyapunov instability of dense Lennard-Jones fluids.** Posch, H.A.; Hoover, W.G. (Institute for Experimental Physics, University of Vienna, Boltzmanngasse 5, A-1090 Vienna, Austria). *Physical Review [Section] A: General Physics;* **38**: No. 1, 473-482(1 Jul 1988).

We present calculations of the full spectra of Lyapunov exponents for 8- and 32-particle systems in three dimensions with periodic boundary conditions and interacting with the repulsive part of a Lennard-Jones potential. A new algorithm is discussed which incorporates ideas from control theory and constrained nonequilibrium molecular dynamics. Equilibrium and nonequilibrium steady states are examined. The latter are generated by the application of an external field F/sub e/ through which equal numbers of particles are accelerated in opposite directions, and by thermostatting the system using Nose-Hoover or Gauss mechanics. In equilibrium (F/sub e/ = 0) the Lyapunov spectra are symmetrical and may be understood in terms of a simple Debye model for vibrational modes in solids. For nonequilibrium steady states (F/sub e/not =0) the Lyapunov spectra are not symmetrical and indicate a collapse of the phase-space density onto an attracting fractal subspace with an associated loss in dimensionality proportional to the square of the applied field. Because of this attractor's vanishing volume in phase space and the instability of the corresponding repellor it is not possible to observe trajectories violating the second law of thermodynamics in spite of the time-reversal invariance of the equations of motion. Thus Nose-Hoover mechanics, of which Gauss's isokinetic mechanics is a special case, resolves the reversibility paradox first stated by J. Loschmidt [Sitzungsber. kais. Akad. Wiss. Wien 2. Abt. 73, 128 (1876)] for nonequilibrium steady-state systems.

38335 **Analytical solutions for the trajectories and thermal histories of unforced particulates.** Cloutman, L.D. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *American Journal of Physics;* **56**: No. 7, 643-645(Jul 1988).

Dilute suspensions of finely dispersed particulates are found in many engineering applications. This article shows that the nonlinear equations of motion and heat transfer for the particles may be solved analytically for certain realistic drag and heat transfer functions under idealized conditions. Some applications are discussed.

38336 **Doering et al. reply.** Doering, C.R.; Bagley, R.J.; Hagan, P.S.; Levermore, C.D. (Department of Physics, Clarkson University, Potsdam, New York 13676). *Physical Review Letters;* **60**: No. 26, 2805-2805(27 Jun 1988).

A reply to the comment on bistability driven by weakly colored gaussian noise is presented.The fokker-planck boundary layer and mean first-passage times are evaluated.It is agreed that there is a difference between the two first-passage times, and that alternative may be more appropriate for quantitative comparison with the low lying spectrum of the Fokker-Planck operator. (AIP)

38337 **Diocotron instability for intense relativistic nonneutral electron flow in planar diode geometry.** Davidson, R.C.; Tsang, K.T.; Uhm, H.S. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **31**: No. 6, 1727-1737(Jun 1988).

The extraordinary-mode eigenvalue equation is used to investigate detailed properties of the diocotron instability for sheared, relativistic electron flow in a planar diode. The theoretical model is based on the cold-fluid-Maxwell equations assuming low-frequency flute perturbations about a tenuous electron layer satisfying ω^2/sub p//sub b/(x)<<ω^2/sub c/ and chemical bondω-kV/sub y/(x)chemical bond^2<<ω^2/sub c/. The cathode is located at x = 0; the anode is located at x = d; the outer boundary of the electron layer is located at x = x^+/sub b/<d; and the inner boundary of the layer is located at x = x^-/sub b/<x^+/sub b/. The extraordinary-mode

38338 **Random vortex methods for the Navier—Stokes equations.** Chien-Cheng Chang. (Lawrence-Berkeley Laboratory and Department of Mathematics, University of California, Berkeley, California 94720). *Journal of Computational Physics;* **76**: No. 2, 281-300(Jun 1988).

Two random vortex methods of Runge—Kutta type are presented for solving the two-dimensional Navier—Stokes equations. We intesgitate the accuracy of these methods by considering the model problem of a rotating flow with initial vorticity concentrated uniformly on a disk of finite radius. Functionals of the numerical solution are computed by Monte Carlo estimates with efficient variance reduction, and the results are compared to those obtained from Euler's method. The numerical results show that both the methods produce errors smaller by one power of the time step size than Euler's method, one seemingly even better than the other. These Runge—Kutta methods are derivations of similar schemes proposed by us in an earlier time for solving stochastic differential equations with constant diffusion coefficients. copyright 1988 Academic Press, Inc.

38339 **Solution of the diffusion equation by finite elements in Lagrangian hydrodynamic codes.** Shestakov, A.I.; Harte, J.A.; Kershaw, D.S. (Computational Physics Division, Lawrence Livermore National Laboratory, P.O. Box 5508, Livermore, California 94550). *Journal of Computational Physics;* **76**: No. 2, 385-413(Jun 1988).

The radiation diffusion equation is solved by the finite element method. The energy densities are point centered. These are integrated into a program architecture which requires zonally averaged quantities. Numerical results are presented which compare the scheme with existing finite difference techniques for zonal variables. Finite elements give better results for transport dominated problems on non-orthogonal meshes such as might be generated by Lagrangian hydrodynamic distortions. copyright 1988 Academic Press, Inc.

38340 **Numerical study of superfluid turbulence in the self-induction approximation.** Buttke, T.F. (Department of Mathematics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Computational Physics;* **76**: No. 2, 301-326(Jun 1988).

Two stable numerical methods are presented to solve the self-induction equation of vortex theory. These numerical methods are validated by comparison with known exact solutions. A new self-similar solution of the self-induction equation is presented and the approximate solutions are shown to converge to the exact solution for the self-similar solution. The numerical method is then generalized to solve the equations of motion of a superfluid vortex in the self-induction approximation where reconnection is allowed. A careful numerical study shows that the mesh spacing of the method must be restricted so that the approximate solutions are accurate. The line length density of a system of superfluid vortices is calculated. Contrary to earlier results it is found that the line length density produced does not scale as the velocity squared and therefore is not characteristic of homogeneous turbulence. It is concluded that the model equationn used is inadequate to describe superfluid turbulence. copyright 1988 Academic Press, Inc.

38341 **Multipulse pre-breakdown phenomena in liquid dielectrics.** Alexeff, I.; Blalock, T.V.; Wintenberg, A.L.; Foust, J.V.; Pace, M.O. (Dept. of Electrical and Computer Engineering, Univ. of Tennessee, Knoxville, TN 37996-2100 (US)). pp 115 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The authors previously observed pre-breakdown behavior from a point in liquid before breakdown as a series of increasing current pulses. Each pulse is generally accompanied by a light flash. In addition, bubble formation is observed. They now developed the following model, which closely fits many of the experimental observations, as well as giving insights into the breakdown process. A bubble detaches from the tip and grows, due to the repulsive electric charges on its inside surface. As the bubble grows,

the electrostatic potential drops, due to the dimension change. This results in a growing potential difference between the bubble and the point. When this difference causes a critical field to appear at the tip, a flashover occurs, a current pulse and a light flash are produced, the bubble charges bck to the tip potential, and the process repeats. Experimental results include as good fit to the observed pulse height vs pulse number, if the effective tip radius is 1/20 of the tip radius used (3 micrometer). The latter observation suggests that the pulse train is initiated by a dust particle in the fluid.

6450 High Energy Physics

38342 **(INIS-mf—11223) Proceedings of the 7 Warsaw symposium on elementary particle physics. Kazimierz, Poland, May 20-26, 1984.** Ajduk, Z. (ed.). (Warsaw Univ. (Poland). Inst. Fizyki Teoretycznej; Institute for Nuclear Studies, Otwock-Swierk (Poland)). 1984. 615p. (CONF-8405236—). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW.

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

41 papers are presented. One of them shows p-barp collider results, 5 describe the status of weak interactions, in 11 hard processes in QCD are considered, 9 is devoted low p/sub T/ versus high p/sub T/ physics and interactions with nuclei, in 6 monopoles, supersymmetry and chiral theories are discussed and in 9 non-perturbative methods are presented. (A.S.).

38343 **(KEK—87-7) Proceedings of the second international conference on hadron spectroscopy.** Oyanagi, Y.; Takamatsu, K.; Tsuru, T. (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jul 1987. vp. (CONF-8704177—). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88780074/JAW.

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

Individual papers in these proceedings are abstracted separately. (LEW)

38344 **(KEK—87-10) Proceedings of the workshop on polarization phenomena.** Horikawa, N.; Tsuru, T. (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1987. vp. (CONF-8605331—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780075/JAW.

From Workshop on polarization phenomena; Ibaraki, Japan (9 May 1986).

Individual papers in these proceedings were abstracted separately. (LEW)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 37439, 37465, 37469, 37470, 37471, 37475, 37531, 37562, 38229, 38246, 38251, 38402, 38470, 38569

38345 **(ANL-HEP-TR—88-07) Argonne National Laboratory High Energy Physics Division semiannual report of research activities, July 1, 1987-December 31, 1987.** (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 88p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010348/JAW.

Progress is reported in experimental and theoretical programs in high energy physics. Experimental facilities research is reported including a nuclear decay experiment and computer services. Also covered are accelerator research and development and SSC detector research and development.

38346 **(BNL—41073) Electroweak and hadron studies.** Rau, R.R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 18p. (CONF-880331—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008772/JAW.

From 3. Lake Louise Winter Institute on quantum chromodynamics: theory and experiment; Lake Louise, Canada (6 Mar 1988).

Some final results are presented on μμ, {tau}{tau}, and hadron production, obtained by the MARK J collaboration at PETRA, over the cm energy band 22 GeV to 46.8 GeV. The MARK J results agree with world averaged data. They constitute powerful tests of the predictions of the Standard Model. 29 refs., 8 figs., 3 tabs.

38347 **(BNL—52091) "Follow that quark!" (and other exclusive stories).** Carroll, A.S. (Brookhaven National Lab., Upton, NY (USA)). 17 Jun 1987. Contract AC02-76CH00016. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010340/JAW.

Quarks are considered to be the basic constituents of matter. In a series of recent experiments, Carroll studied exclusive reactions as a means of determining the interactions between quarks. Quantum Chromo-dynamics (QCD) is the modern theory of the interaction of quarks. This theory explains how quarks are held together via the strong interaction in particles known as hadrons. Hadrons consisting of three quarks are called baryons. Hadrons made up of a quark and an antiquark are called mesons. In his lecture, Carroll describes what happens when two hadrons collide and scatter to large angles. The violence of the collision causes the gluons that bind the quarks in a particular hadron to temporarily lose their grip on particular quarks. Quarks scramble toward renewed unity with other quarks, and they undergo rearrangement, which generally results in additional new particles. A two-body exclusive reaction has occurred when the same number of particles exist before and after the collisions. At large angles these exclusive reactions are very rare. The labels on the quarks known as flavor enable the experimenter to follow the history of individual quarks in detail during these exclusive reactions. Carroll describes the equipment used in the experiment to measure short distance, hard collisions at large angles. The collisions he discusses occur when a known beam of mesons or protons collide with a stationary proton target. Finally, Carroll summarizes what the experiments have shown from the study of exclusive reactions and what light some of their results shed on the theory of QCD.

38348 **(BONN-HE—87-30) Particle production at collider energies.** Geich-Gimbel, C. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Nov 1987. 161p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753534/JAW.

Key features of the SPS panti p Collider and the detectors of the UA-experiments involved are dealt with in chapter 2, which includes and accord to the ramping mode of the Collider, which allowed to raise the c.m. energy to 900 GeV in the UA5/2 experiment. The following chapters concentrate on physics results. Starting with a discussion of cross sections and diffraction dissociation in chapter 3 we then continue with a presentation of basic features of particle production such as rapidity and multiplicity distributions in chapter 4. There one of the unexpected findings at Collider energies, the breakdown of the so-called KNO-scaling, and new regularities potentially governing multiplicity distributions, are discussed. The findings about correlations among the final state particles, which may tell about the underlying dynamics of multi-particle production and be relevant to models thereof, are described in due detail in chapter 5. Transverse spectra and their trends with energy are shown in chapter 6. Results on identified particles are collected in a separate chapter in order to stress that this piece of information was an important outcome of the UA5 experiment. (orig./HSI).

38349 **(DOE/ER/40272—54) Continuum charm production in e^+-e^- annihilation at root s = 10.55 GeV.** Garren, L. (Florida Univ., Gainesville (USA). Dept. of Physics). Apr 1988. Contract FG05-86ER40272. 12p. (CONF-880331—5; UFTP—88-3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011617/JAW.

From 3. Lake Louise Winter Institute on quantum chromodynamics: theory and experiment; Lake Louise, Canada (6 Mar 1988).

The author reports results on the differential and total cross sections for inclusive production of the charmed particles D/sup *+/, D/sup *0/, D^0, D^+, D/sub s/, and Λ/sub c/ in e^+e^- annihilations at root s = 10.55 GeV. Relevant quark fragmentation models

are compared with the measured charmed particle distributions. We measure B(D/sup *+/ -> D°π^+) = 0.52 +/- 0.07 +/- 0.11.

38350 **(IFVE-OEF—87-44) Observation of the asymmetry in the πp parrow up -> ($\pi^0\pi^0$)n reaction.** Apokin, V.D.; Belikov, N.I.; Derevshchikov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702066/JAW.

The experimental results on polarization asymmetry in the π^-p/sub f/ -> ($\pi^0\pi^0$) n reaction at 39.1 GeVc are presented. A negative asymmetry ~ 10% is observed in the $\pi^0\pi^0$-mass region of 600-110 MeVc^2, and it enhances to ~ 30% in the region of F_2(1270 and f_4(2030)-resonances. 10 refs.; 7 figs.

38351 **(IFVE-OEIUNK—87-62) Investigation of neutral strange particle correlation in pp interactions at 360 GeV/c.** Asai, M.; Aziz, M.; Baland, Zh. and others. (Hiroshima Univ. (Japan); Tata Inst. of Fundamental Research, Bombay (India); Mons Univ. (Belgium)). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702857/JAW.

Production properties and corrections for K/sub S/°K/sub S/°, K/sub S/°Λ, K/sub S/°Λ-bar and $\Lambda\Lambda$-bar system in 360 GeVc pp interactions are presented. All rapidity difference distributions are observed to peak at $\Delta Y=0$. Experimental results are in good agreement with the quark fusion and Lund models of particle production. 7 refs.; 3 figs.

38352 **(IFVE-ONF—87-60) Study on the K^+p -> $K^0 2\pi^+\pi^-p$, K^+p -> $K^0 3\pi^+ 2\pi^-p$ reactions and their diffractive channels at 32 GeVc.** Gerdyukov, L.N.; Shlyapnikov, P.V.; Makharadze, T.G.; Tomaradze, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702075/JAW.

Results of study of the main characteristics of the reactions K^+p -> $K^0 2\pi^+\pi^-p$, K^+p -> $K^0 3\pi^+ 2\pi^-p$ and their diffractive dissociation channels K^+ -> $K^0 2\pi^+\pi^-$, K^+ -> $K^0 3\pi^+\pi$-, obtained in experiment with the hydrogen bubble chamber "Mirabelle" are presented. 8 refs.; 8 figs.

38353 **(IFVE-ONF—87-81) Study on the nucleon structure functions in neutrino interactions in energy range of 10-200 GeV.** Ammosov, V.V.; Burtovoj, V.S.; Gapienko, V.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702859/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The results on measurement and analysis of the nucleon structure functions F_2 and xF_3 obtained in the (anti)neutrino experiment in the 15 foot bubble chamber are presented. The scaling violation in the non-singlet structure function is analysed in terms of the perturbative QCD. The perturbative QCD scale parameter was found to be: Λ/sub M-barS-bar/=0.17 +- 06 (stat)+-0.12(syst) GeV. The attempt to determine a contribution of higher twist effects in scaling violation are also made. 28 refs.; 7 figs.; 5 tabs.

38354 **(INFN-LNF—87-105(R)) Analysis of nucleon form factor data reveals the e^+e^-->nucleon-antinucleon cross section to be remarkably larger than the e^+e^-->proton-antiproton one.** Dubricka, S. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702863/JAW.

A modified six-resonance VMD model for a description of the nucleon electromagnetic structure is constructed. It possesses correct analytic properties and the asymptotic behaviour in accordance with a quark model prediction for baryons. Only parameters with clear physical meaning are contained in the model. They are evaluated numerically in a simultaneous fit of all existing data on electric and magnetic nucleon form factors. As a result, the behaviour in the time-like region of electric and magnetic neutron form factors, for which there are no data up to now, has been predicted. In comparison with the corresponding behaviour of proton form factors above the nucleon-antinucleon threshold one finds them to exceed by a factor of five. Consequently the cross section of e^+e^-->nucleon-antinucleon is expected to be roughly twenty-five-times as large as the cross section of e^+e^-->proton-antiproton. 58 refs.

38355 (INIS-mf—11223, pp 9-58) **High transverse momentum electrons in the UA2 experiment.** Bagnaia, P.; Banner, M.; Battiston, R. (European Organization for Nuclear Research, Geneva (Switzerland); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Perugia Univ. (Italy)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The final results of the search for electrons with transverse momentum p/sub T/ > 15 GeVc carried out in the data sample available from the UA2 experiment are given. The main motivation for this study is a comparison with improved statistics between the experimental data and the expectations from reactions p-bar + p -> W^{+-} + anything where W^{+-} -> e^{+-} + ν (ν-bar) and p-bar + p -> Z^0 + anything where Z^0 -> $e^+ + e^-$ or $e^+ + e^- + \gamma$. A general discussion is presented on the topology of all events which contain a high p/sub T/ electron candidate, in particular with regard to the possible presence of hadronic jets in some of these events. 11 refs., 4 tabs. and 15 figs. (M.F.W.).

38356 (INIS-mf—11223, pp 113-122) **Improved measurement of neutrino-electron scattering with the CHARM calorimeter.** Bergsma, F.; Dorenbosch, J.; Allaby, J.V. 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

A new experimental determination of the electroweak mixing angle θ/sub w/ is reported based on a second exposure of the CHARM calorimeter to the CERN SPS wide-band beam. The ratio R of muon-neutrino and muon-antineutrino electron scattering cross-sections has been determined from a sample of 37 +- 10 and 35 +- 10 events. The experimental result is R = 1.26 + 0.72-0.45, corresponding to a value of $\sin^2\theta$/sub w/ = 0.216 +- 0.055. The total sample of events collected in the CHARM calorimeter during the two exposures is (83 +- 16) ν/sub μ/e events and (112 +- 21) ν-bar/sub μ/e events, leading to the final result $\sin^2\theta$/sub w/ = 0.215 +- 0.032. The systematic error is estimated to be +- 0.012. 8 refs., 2 figs.

38357 (INIS-mf—11223, pp 247-259) **Spectroscopy in the γ region.** Wegener, D. (Dortmund Univ. (Germany, F.R.). Inst. fuer Physik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The results available from the ARGUS detector, a new detector built for DORIS electron positron storage ring, are presented. The first results on the T(2S) -> $\pi^+\pi^-$T(1S) and T(2S) -> $\gamma+1^3$P/sub j/ decays , the fragmentation functions of charmed quarks into D/sup */-and F-meson and the first results on B-meson decay are discussed. 17 refs., 12 figs., 1 tab. (M.F.W.).

38358 (INIS-mf—11223, pp 579-587) **QCD effects in final state hadrons from deep inelastic muon scattering.** Janata, F. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

New results are presented from an experiment on deep inelastic muon-proton scattering performed by the European Muon

Collaboration. Effects predicted by QCD are investigated by studying the final state hadrons. It is found that the predictions of the quark-parton and fragmentation models are sufficient to explain the W dependence of the total charged multiplicity whereas clear evidence for perturbative and nonperturbative QCD effects can be demonstrated by the behaviour of the transverse momentum of the final state hadrons. 12 refs., 7 figs.

38359 (INIS-mf—11223, pp 607-615) **TASSO results on baryon production in high energy e^+e^- annihilation jets.** Pandoulas, D. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The measured yields of baryon production in high energy e^+e^- annihilation make possible the study of events in which at least two baryons are detected in the final state. Clear evidence is found that the mechanism for baryon-antibaryon production in e^+e^- annihilation is dominated by local compensation of baryon number. Production of decuplet baryons is found to be strongly suppressed with respect to octet baryon production. At 95% confidence there are on average <0.10 Δ^{++} and <0.09 Σ/sup *+-/ per event (inclusive of antiparticles). 15 refs., 3 figs.

38360 (INIS-mf—11223, pp 163-175) **Large transverse momentum π^0 and direct photon production in π^-p, π^+p and pp collisions at 300 GeVc.** De Marzo, C.; De Palma, M.; Favuzzi, C. (Bari Univ. (Italy). Ist. Nazionale di Fisica Nucleare; Bari Univ. (Italy). Ist. di Fisica). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

Preliminary results on large transverse momentum π^0 and direct photon production in π^-p, π^+p and pp collisions at 300GeVc are presented. It was found that the $\gamma\pi^0$ cross-section ratio is increasing with increasing p/sub T/ for π^-p, π^+p and pp collisions. No striking difference between the direct photon production cross-section in π^-p and π^+p collisions has been observed up to p/sub T/=5 GeVc. 9 refs., 9 figs.

38361 (INIS-mf—11223, pp 189-199) **Squark versus top quark production. Zen events at the CERN collider.** Argyres, E.N.; Contogouris, A.P.; Tanaka, H. (State Univ. Coll., Plattsburgh, NY (USA); McGill Univ., Montreal, Quebec (Canada). Dept. of Physics). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

First, production of top quark decaying into bottom electron and neutrino versus production of squark decaying into quark, electron and sneutrino is studied in p-barp collisions at $\sqrt{s}$=540 GeV. With branching ratios determined in detail, it is found that squark production well exceeds that of top quark except when the gluino is heavy. Next, using certain cross sections obtained before, the recently observed zen events (monojet or "photon" plus missing p/sub T/) are explained in terms of squark production and the decay squark -> quark + photino. 12 refs., 2 figs.

38362 (INIS-mf—11223, pp 239-245) **Short and long range correlation of hadrons in pp-bar collisions at 540 GeV.** Boeckmann, K.; Eckart, B. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

Forward-backward multiplicity correlations and two-particle pseudorapidity correlations are investigated in pp-bar collisions at 540 GeV. The analysis in terms of a simple cluster approach yields values of k/sub eff/ $\sim$ 2.5 for the effective cluster size for the decay in charged particles and a decay width for the clusters of $\delta \sim 0.7$ units in pseudorapidity. These values are almost unchanged when compared with those determined at ISR energies. 14 refs.

38363 (INIS-mf—11223, pp 297-311) **Kaon and baryon production in high p/sub T/ pp,dd and $\alpha\alpha$ interactions at ISR energies.** Szczekowski, M. (Institute of Nuclear Research, Warsaw (Poland); European Organization for Nuclear Research, Geneva (Switzerland)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The fractions of kaons and baryons are determined for high p/sub T/ collisions of protons, deuterons and alpha particles at ISR energies. The fractional yield of protons depends strongly on a scattering angle whereas the one for antiprotons remains constant. The measured particle ratios depend on the atomic weight A of the beam particles. 5 refs., 12 figs.

38364 (ITEF—113(1987)) **Observation of the strange exotic resonances in $\Lambda\pi i\pi^+$ system.** Drutskoj, A.G.; Mikhajlichenko, V.I.; Nikitin, S.Ya.; Kiselevich, I.L.; Shidlovskij, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702102/JAW.

Search for strange exotic baryon resonances is carried out in π^+p-interaction at 4.23 GeVc π^+-meson momentum. Except ΛPI^+PI^+ mass distribution, characteristic properties of mass spectra of exotic states don't exceed .5 μb. Exceedings over the phase volume of $PI^+p \to \Lambda K^0PI^+PI^+$ reaction in the spectrum of effective ΛPI^+PI^+ masses are detected. Methods for phase distribution construction are described taking into account $\Sigma^{0+}(1385)$ and $K^{0+}(890)$ known resonances and separation of resonance peaks. 11 refs.; 1 tab.; 5 refs.

38365 (KEK—87-7, pp 56-63) **Partial wave analysis of K^+K-bar/sub S/π^- final state.** Protopopescu, S.D. (Brookhaven National Lab., Upton, NY (USA)). Jul 1987. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88780074/JAW. (CONF-8704177—).

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

A partial wave analysis of high statistics data collected by AGS Experiment no.771 in reaction $\pi^-p \to K^+K$-bar/sub S/$\pi^- + n$ shows evidence for a 1^{++} and a 0^{-+} state in the 1280 MeV region, a 0^{-+} state in the 1420 MeV region and a 1^{++} state in the 1500 MeV region. Preliminary data from reaction $K^-p \to K^+K$-bar/sub S/$\pi^- + X$ are presented.

38366 (KFK—4359) **Search for narrow lines in photon spectra from proton-antiproton annihilations at rest.** Schwertel, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Feb 1988. 115p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753391/JAW.

Inclusive photon spectra from annihilation of antiprotons stopped in a liquid hydrogen target were measured at LEAR (CERN) with a magnetic pair spectrometer. The FWHM energy resolution of the spectrometer in the region from 100-700 MeV was in the range from 2 to 4.5%. A total number of about $4.8.10^6$ events with energies up to 1 GeV have been reconstructed. The photon spectra were scanned for possible lines with widths comparable to spectrometer resolution indicating the existence of bound nucleon-antinucleon states. No such structures were found with branching ratios greater than 4 to 8.10^{-4} at 95% confidence level. Results of former experiments could not be confirmed.

38367 (LA—11273-T) **Measurement of the left-right asymmetry in pion-proton radiative exchange and charge exchange scattering from 301 to 625 MeV/c on a transversely polarized target.** Kim, George Jung-Kwang. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 151p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88009808/JAW.

The left-right asymmetry A/sub N/ in π/sup {minus/}p $\rightarrow$ γn has been measured at p/sub π = 301, 316, 427, 471, 547, 586, and 625 MeV/c using a transversely polarized target. The final-state neutron and gamma were detected in coincidence by two states of matching neutron and gamma detectors at gamma angles centered around 90{degree and 110{degree} c.m. A gamma detector consisted of an array of 15 counters, each was 15{times}15{times}25 cm^3 block of lead-glass. A neutron detector consisted of 15 counters also, each one was a cylindrical plastic scintillator 7.6 cm in diameter and 45.7 cm long. The A/sub N/ results are compared with the predictions from the most recent single-pion photoproduction partial-wave analysis by Arai and Fujii. The agreement is poor, casting doubt on the correctness of the value for the radiative-decay amplitude of the neutral Roper resonance now in use. A comparison is made with the 90{degree}recoil proton polarization data of the inverse reaction derived from γd scattering, there are substantial discrepencies. Charge exchange (π/sup {minus/p} $\rightarrow$ γ{degree}n) events were the major yield in this experiment. Very precise values of the charge exchange analyzing power were obtained with an error of typically 3%. The charge exchange results are compared with the predictions from recent γn partial wave analyses. At the lower incident energies little difference is seen between the VPI, Karlsruhe-Helsinki, and CMU-LBL analyses, and there is excellent agreement with our experiment. From the onset of the Roper resonance the VPI solution is strongly favored.

38368 (LA-UR—88-1729) ETA meson production at LAMPF. Peng, J.C. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 13p. (CONF-8803108—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010951/JAW.

From Workshop on production and decay of light mesons; Paris, France (3 Mar 1988).

Recent experiments at LAMPF to study pion-induced eta meson production are discussed. Results from the π/sup {minus/}p $\rightarrow$ {eta}n and π/sup {minus/3}He $\rightarrow$ {eta}t reactions, potentially useful for tagged-{eta} production, are presented. Mass and energy dependence of the inclusive (π,{eta}) cross sections are shown to provide information on {eta}-nucleus interaction. Preliminary results from a BNL experiment to search for {eta}-nucleus bound states are presented.

38369 (LBL—23737) Charged hadron production in e/sup {+/}e/sup {-/} annihilation at $\sqrt{s}$ = 29 GeV. Aihara, H.; Alston-Garnjost, M.; Avery, R.E.; Barbaro-Galtieri, A.; Barker, A.R.; Barnett, B.A.; Bauer, D.A.; Bengtsson, H.U.; Bobbink, G.J.; Buchanan, C.D. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 98p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88008396/JAW.

We have used data from the Time Projection Chamber at the SLAC storage ring PEP to study the inclusive production of charged hadrons in e/sup {+/}e/sup {-/} annihilation at a center of mass energy of 29 GeV. Charged particles were identified by simultaneous dEdx and momentum measurements. We present cross sections and particle fractions for π{sup{plus+-minus}}, k^{+-}, and p{ovr{p}}} as a function of energy, momentum, rapidity, and transverse momentum. We compare the predictions of various hadronization models to the data and note discrep ncies at high momentum.

38370 (LBL—24729) The inclusive cross section of charged hadrons in 3-jet events at $\sqrt{s}$ = 29 GeV. Rouse, F.R. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 235p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88008241/JAW.

We examine the cross section for the production of charged hadrons in 3-jet events produced from e/sup {plus/e/sup {minus/} annihilation at 29 GeV center of mass energy. The data was taken at the Pep-4Time Projection Chamber between 1983-1984. In particular we are interested in the production of hadrons by the particle which mediates the strong interaction, the gluon. We find that the number of protons produced by the fragmentation of the gluon is at variance with the LUND model of fragmentation. 85 refs., 72 figs., 29 tabs.

38371 (LBL—25353) Threshold behavior of direct electron production in proton-beryllium collisions. Naudet, C.; Krebs, G.F.; Lallier, E.; Letessier-Selvon, A.; Matis, H.S.; Roche, G.; Schroeder, L.; Seidl, P.; Yegneswaren, A.; Wang, Z.F. (Lawrence Berkeley Lab., CA (USA); California Univ., Los Angeles (USA). Dept. of Physics; Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Physics; Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy; Northwestern Univ., Evanston, IL (USA). Dept. of Physics). May 1988. Contract AC03-76SF00098. 8p. (CONF-8805142—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012017/JAW.

From 3. conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The authors report measurements of direct electron pair production in p-Be interactions at 1.0, 2.1 and 4.9 GeV kinetic beam energies. The invariant mass and p/sub t/ spectra along with the total cross sections are presented. A rapid decrease in the total cross section is observed at the lowest energy.

38372 (PITHA—87-22) Dimuon production at the CERN p anti p collider. Moser, H.G. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.; Technische Hochschule Aachen (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). Oct 1987. 201p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753392/JAW.

In panti p collisions at 630 (540) GeV centre of mass energy heavy quarks are copiously produced, mainly by gluon fusion. About 10% of them decay semileptonically into muons. In order to study heavy quark physics at the collider, we selected dimuon event satisfying following cuts: P/sub t/ $>$ 3 GeVc (each muon) m/sup $\mu\mu$/ $>$ 6 GeVc^2. (orig.HSI).

38373 (SLAC-PUB—4607) Evidence for D/sub s/ decay to {eta}π from Mark III. Brient, J.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1988. Contract AC03-76SF00515;AC02-76ER01195;AC03-81ER40050. 5p. (CONF-880399—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010151/JAW.

From 23. Rencontre de Moriond: current issues in hadron physics; Les Arcs, France (13 Mar 1988).

This paper presents the evidence for a decay mode of the D/sub s/ state, obtained using the Mark III detector at the e/sup {plus/}e/sup {minus/} storage ring SPEAR. We report the observation of the decay Ds/sup {plus/} $\rightarrow$ {eta}π/sup {plus/} in two channels ({eta} $\rightarrow$ $\gamma\gamma$ and {eta} $\rightarrow$ π/sup {plus/}π/sup {minus/}π^0). The product branching fraction is measured to be σ(e/sup {plus/}e/sup {minus/} $\rightarrow$ D/sub s//sup {plus/}D/sub s/*/sup {minus/} + c.c.) {times} B(D/sub s//sup {plus/} $\rightarrow$ {eta}π/sup {plus/}) = 80 +- 20 +- 25 pb and 74 +- 19 +- 25 pb for the $\gamma\gamma$ and π/sup {plus/}π/sup {minus/}π^0 channels, respectively. These values are approximately twice the rate of D/sub s/ $\rightarrow$ {phi}π.

38374 (SLAC-PUB—4613) Semileptonic Λ/sub c/$^+$ decays with the Mark II at PEP. Klein, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1988. Contract AC03-76SF00515. 5p. (CONF-880399—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010150/JAW.

From 23. Rencontre de Moriond: current issues in hadron physics; Les Arcs, France (13 Mar 1988).

Semileptonic Λ/sub c/$^+$ decays have been observed in 29 GeV e$^+$e/sup {minus/ annihilation. We observe the channels Λ/sub c/$^+$ $\rightarrow$ e$^+$AX and Λ/sub c/$^+$ $\rightarrow$ $\mu\mu$AX. The production rate for Λ/sub c/$^+$, times Br(Λ/sub c/ $\rightarrow$ l$^+$AX) of 0.0031 +- 0.0012 +- 0.0010 per hadronic event for electrons, and 0.0024 +- 0.0007 per hadronic event for muons. When combined with the Lund model prediction for Λ/sub c/$^+$ production, this gives semileptonic branching ratios of roughly 5% about what is expected. When combined with the UCLA model prediction for Λ/sub c/$^+$ production, this gives semileptonic branching ratios of 17% and 13% for electrons and muons, somewhat higher than expected.

38375 Formation of spin-one mesons by photon-photon fusion. Aihara, H.; Alston-Garnjost, M.; Avery, R.E.; Barbaro-Galtieri, A.; Barker, A.R.; Barnett, B.A.; Bauer, D.A.; Bay, A.; Bengtsson, H.; Bobbink, G.J.; and others. (Lawrence Berkeley Laboratory, Berkeley, California 94720 University of California, Davis, California 95616 University of California Intercampus Institute for Research at Particle Accelerators, Stanford, California 94305 University of California, Los Angeles, California 90024 University of). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 1, 1-18(1 Jul 1988).

We have observed the formation of two spin-one mesons in $\gamma\gamma$ fusion reactions in which one photon was highly virtual. The first, consistent with being the J/sup P//sup C/ = 1/sup ++/ $f_1(1285)$, was seen in the final state eta$\pi^+\pi^-$ (eta→$\gamma\gamma$), as was the eta'(958). We have previously reported the observation of the second spin-one state, the X(1420), in the final state K/sup +- /K/sub S/$^0\pi$/sup minus-or-plus/ (K/sub S/^{0}→$\pi^+\pi^-$). The formation of this state, which may be the $f_1(1420)$ observed in hadronic interactions, is reanalyzed using a new model and more data. We consider whether the X(1420) could be the partner of the $f_1(1285)$ in the J/sup P//sup C/ = 1/sup ++/ meson nonet. The $\gamma\gamma$/sup */ width of each resonance was determined in several Q^2 bins. Using a model due to Cahn with a rho form factor, we obtained for the coupling parameter Gamma-tilde/sub γ//sub γ/($f_1(1285)$) the value 2.4 +- 0.5 +- 0.5 keV.

38376 New measurements of properties of the Ωp hyperon. Luk, K.B.; Beretvas, A.; Deck, L.; Devlin, T.; Rameika, R.; Whitman, R.; Handler, R.; Lundberg, B.; Pondrom, L.; Sheaff, M.; and others. (Department of Physics and Astronomy, Rutgers: The State University, P.O. Box 849, Piscataway, New Jersey 08854). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 1, 19-31(1 Jul 1988).

We have obtained a sample of 1743 reconstructed Ω^-→ΛK^- events produced by protons on a Be target at production angles of 5.0 and 7.5 mrad. The Ω^- lifetime, based on a subset of 1096 events, was measured to be tau(Ω^-) = (0.811 +- 0.037) x 10^{-10} sec, where the uncertainty is statistical and the systematic uncertainty is estimated to be small. The helicity of the daughter Λ yielded the product of asymmtery parameters α/sub Λ/α/sub Ω/ = -0.022 +- 0.051 which, in turn, yields α/sub Ω/ = -0.034 +- 0.079. The average daughter-Λ polarization in the decay region was measured to be P/sub Λ/ = 0.12 +- 0.08 approximately perpendicular to the charged-hyperon beam line. The Ω^- polarization in the same region, i.e., after the precession magnet, depends on the sign of γ/sub Ω/, which is unknown at present. The two possibilities are P/sub Ω/ = P/sub Λ/ if γ/sub Ω/≅+1 and P/sub Ω/ = -(5/3P/sub Λ/ if γ/sub Ω/≅-1. The magnitude of the polarization vector is only 1.5 standard deviations different from zero, and this prevented a meaningful measurement of the Ω^- magnetic moment. If the broken-SU(6) prediction for the moment, $\mu(\Omega^-)$ = -1.83μ/sub N/, is assumed to be true, then the precession of the Ω^- in the magnetic field is small and the values of P/sub Ω/ above are also true at the production target. If this polarization is different from zero and correct in sign, then it cannot be simultaneously reconciled with theoretical predictions for the sign of γ/sub Ω/ and for the sign of the production polarization.

38377 Production of flavor-changing gauge bosons from E_6 at e^+e^- and hadron colliders. Rizzo, T.G. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 1, 71-77(1 Jul 1988).

We have studied the production and corresponding decay signatures of flavor-changing neutral gauge bosons which can arise when E_6 breaks to give a new low-energy gauge group SU(2)/sub I/ at e^+e^- and hadron colliders. The non-Hermitian gauge bosons (W/sub I/) in this group couple conventional fermions (e.g., e,d/sup c/) to their exotic partners (E,h/sup c/) in the 27 representation of E_6. The dominant mechanism for W/sub I/ production in hadron-hadron collisions at the parton level is found to be g+d→W/sub I/+h, which leads to a substantial cross section at both the Superconducting Super Collider and the CERN Large Hadron Collider as well as distinct decay signatures. Pair production of W/sub I/ at high-energy e^+e^- colliders is found to be sensitive to detailed cancellations between the different amplitudes. Sizable production cross sections of order 1 pb are obtained.

38378 Increased statistics and observation of the g/sub T/, gsub(T'), and g(subT'') 2^{++} resonances in the glueball enhanced channel π^-p -> phiphin. Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; Lindenbaum, S.J.; Chan, C. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). *Physics Letters* [*Section*] *B;* **201**: No. 4, 568-572(18 Feb 1988). Contract AC02-76CH00016;AC02-83ER40107.

In a new experiment we have obtained 3006 new events in the reaction π^-p -> phiphin, approximately doubling the statistics which now total 6658. A refined partial wave analysis of the phiphi system again reveals three resonances (g/sub T/, gsub(T'), gsub(T'')) with I/sup G/J/sup PC/ = 0^+2^{++}. The absence of the OZI suppression, and the observation of only three J/sup PC/ = 2^{++} states (g/sub T/, gsub(T'), gsub(T'')) which comprise virtually all the cross section are unusual characteristics of the data. The large phiphin signal occurs over a mostly structureless and incoherent phiK^+K^-n background. All these unusual characteristics are well explained if these states are produced by 1-3 glueballs (multigluon resonances).

38379 Associated production of weak bosons and heavy quarks with hadron colliders. Halzen, F.; Kim, C.S. (Physics Dept., Univ. of Wisconsin, Madison, WI (US)). *International Journal of Modern Physics A;* **2**: No. 4, 1069-1074(Aug 1987). (CONF-8705163—).

From Madison SSC workshop: from colliders to supercolliders; Madison, WI, USA (11 May 1987).

The authors calculate the joint production of W/sup +-/ and top quarks via the leading order diagrams bt-bar→W and bg-bar→Wt. Although the latter contribution is O(α/sub s/) the authors find it to be sizeable and to subtract from the leading order bt-bar→W. The calculations are of interest as they represent the dominant background in the search of charged Higgs particles H/sup +-/ → tb-bar in the minimal SUSY model With this in mind the authors also present results for the rho/sub T/ distribution of the top and the dilepton invariant mass resulting from leptonic decay of both particles in the Wt final state.

38380 Production of heavy squarkonium at the SSC. Herrero, M.J.; Mendez, A.; Rizzo, T.G. (Theory Group, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *International Journal of Modern Physics A;* **2**: No. 4, 1121-1130(Aug 1987). (CONF-8705163—).

From Madison SSC workshop: from colliders to supercolliders; Madison, WI, USA (11 May 1987).

The authors study the production of heavy bound sttes of squarks at the SSC and analyse their decays into longitudinal W's and Z's. In some situations a squarkonium state can be detected through its decay into a pair of W's.

38381 Planned neutrino electron experiment. White, D.H. (Los Alamos National Lab., NM (USA)). pp 16 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

H^- beam from the 800 MeV linear accelerator at LAMPF is injected into a proton storage ring (PSR) and extracted in a pulse 250ns long. It is proposed that this beam be used to generate a time separated neutrino source from stopped pions and muons in a beam stop utilizing the time structure and the lifetimes of the pion (26 ns), and muon (2200ns). The ratio of neutrino electron scattering from pion decay and muon decay is sensitive to sin ^{2}theta/sub w/, the mixing angle of the electroweak theory. A measurement of the ratio of cross sections is expected to give a precision of 1% on sin ^{2}theta/sub w/, testing precisely the form of the theory.

38382 Hadronic matter in collision: Proceedings of the second international workshop on local equilibrium in strong interaction physics. Carruthers, P.; Stottman, D. Teaneck, NJ; World Scientific Pub. Co, (1986). 537p. (CONF-860440—). World Scientific Pub. Co., 687 Hartwell Street, Teaneck, NJ 07666.

From 2. international workshop on local equilibrium in strong interaction physics: hadronic matter in collision; Santa Fe, NM, USA (9 Apr 1986).

This book contains papers given at a conference on hadronic matter in collision. Some of the topics include the following: Nuclear Fragmentation; Nucleus-Nucleus Reactions; Phase Transformations; Hydrodynamics of Nuclear Matter; Hadron Hadronic Multi-Particle Production; and Bose Einstien Correlations.

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REFER ALSO TO CITATION(S) 38225, 38254, 38345, 38347, 38361, 38382, 38468, 38506, 38664

38383 (BNL—41182) Measurement of hadronic exclusive reactions at high momentum transfer as tests of perturbative QCD [quantum chromodynamics]. Carroll, A.S. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 12p. (CONF-880331—4). NTIS, PC A03;3. Order Number DE88010230/JAW.

From 3. Lake Louise Winter Institute on quantum chromodynamics: theory and experiment; Lake Louise, Canada (6 Mar 1988).

Exclusive reactions are defined and described in terms of perturbative QCD. Color transparency is discussed, and exclusive reactions are compared. (LEW)

38384 (BNL—41255) Proton decay by monopoles and strings. Matheson, A. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-8803109—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88010669/JAW.

From 23. Rencontre de Moriond conference: electroweak interactions and unified theories; Les Arcs, France (6 Mar 1988).

Order-of-magnitude estimates are obtained for fermion-monopole and fermion-string scattering, taking into account the effect of the monopole or string on the fermion wavefunction. As a result, it is concluded that monopoles will catalyze proton decay with a strong cross-section (the Callan-Rubakov effect) whereas for strings the process has a geometrical cross-section. The difference is explained as being due to a long range attractive potential between the fermion and the monopole, and the absence of long range fields in the case of the string.

38385 (DOE/ER/40200—139) Comparison of exact and effective gauge boson calculation for gauge boson fusion processes. Abbasabadi, A.; Repko, W.W.; Dicus, D.A.; Vega, R. (Michigan State Univ., East Lansing (USA). Dept. of Physics and Astronomy; Texas Univ., Austin (USA). Center for Particle Theory). Mar 1988. Contract FG05-85ER40200. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010243/JAW.

The exact perturbative calculations for the gauge boson fusion processes W^+W/sup {minus/} $\rightarrow$ W^+W/sup {minus/}, W^+W/sup {minus/} $\rightarrow$ Z^0Z^0, and W^+W/sup {minus/} $\rightarrow$ H^0H^0 are compared with the corresponding effective gauge boson calculations. These comparisons enable us to study the several forms of the gauge boson distribution functions and draw some conclusions about their non-leading terms. In addition, it is possible to study effects of various rapidity cuts on the exact and approximate calculations. For rapidity cuts {eta}/sub C/ satisfying $1.0 \leq$ {eta}/sub C/ ≤ 2.0, the agreement is excellent. Larger rapidity cuts reveal factor of 2–3 disagreements when the invariant mass of the final state is large compared to the Higgs mass. In all cases, the agreement near the Higgs peak is good. The discrepancies are discussed in terms of the extra diagrams which occur in the exact calculations and the t-channel singularities which are present in the effective gauge boson calculations.

38386 (DOE/ER/40228—T1) [Theoretical studies in high energy physics]: Final technical report. Braaten, E. (Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy). [1988]. Contract FG02-85ER40228. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011606/JAW.

The research activities that were supported by this grant were focused primarily on low energy quantum chromodynamics. Significant progress was made in the Skyrme model for baryons, string models for color flux tubes, hadronic decays of the {tau} lepton, technicolor models of the electroweak interactions, and meson form factors in perturbative QCD.

38387 (DOE/ER/40235—T3) Theoretical studies in elementary particle physics. Collins, J.C. (Illinois Inst. of Tech., Chicago (USA)). 1988. Contract FG02-85ER40235. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006929/JAW.

This report briefly discusses the elementary particle physics research being done at Illinois Institute of Technology. Some of the work in progress is: understanding the foundations of perturbative QCD in its applications to hadron-hadron scattering; studies of the QCD predictions for the angular distribution of the muons produced in the Drell-Yan process; the small-x regime and cosmic ray signals from Cygnus X-3.

38388 (FNAL/C—88/32) Beauty physics at the ultrahigh energies of the ELOISATRON [Euroasiatic Long Intersecting Superconducting Accelerator Synchrotron]. Cox, B. (Fermi National Accelerator Lab., Batavia, IL (USA)). Feb 1988. Contract AC02-76CH03000. 11p. (CONF-8706291—1). NTIS, PC A03;3. Order Number DE88008053/JAW.

From 5. INFN-ELOISATRON workshop on new aspects of very high energy proton proton physics; Erice, Italy (1 Jun 1987).

The potential for experimentally studying B physics at the proposed INFN 100 TeV ELOISATRON (Euroasiatic Long Intersecting Superconducting Accelerator Synchrotron) is compared with possibilities at 40 TeV at the Superconducting Super Collider. The effect of the increase in center of mass energy on the production and decay of B mesons has been investigated, particularly with respect to the accummulation of large samples of B hadron decays necessary for the detection of CP violating effects. 13 refs., 7 figs., 1 tab.

38389 (FNAL/C—88/33) Experimental possibilities for observation of CP violation in B decay. Cox, B. (Fermi National Accelerator Lab., Batavia, IL (USA)). Feb 1988. Contract AC02-76CH03000. 30p. (CONF-8709147—10). NTIS, PC A03;3. Order Number DE88008055/JAW.

From International symposium on the production and decay of heavy flavors; Stanford, CA, USA (1 Sep 1987).

The detection and the measurement of CP violation in the decays of B hadrons will require the accumulation of large numbers of B decays in particular exclusive modes. The potential of beauty hadroproduction experiments for obtaining these large data samples is examined in the context of various trigger and analysis strategies. The possibilities for doing such experiments at present hadron machines is compared with the potential for such experiments at the SSC. 3 refs., 3 figs., 4 tabs.

38390 (IFVE-OTF—87-9) Mass formula for mesons containing light quarks. Khrushchev, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702081/JAW.

Two-parametric mass formula for mesons, which contain u- and d-quarks, is proposed and the mass values for radially excited states of π- and rho-mesons and mesons with large spin are calculated. This values coincide with experimental ones within 1-3% of accuracy for orbitally excited states and for radially excited states - within 3-6%. 12 refs.; 2 tabs.

38391 **(IFVE-OTF-ONF/OEIUNK—87-23) Search for B/sub s/-meson oscillations in high energy hadronic beams.** Volkov, G.G.; Likhoded, A.K.; Slabospitskij, S.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702087/JAW.

Simple expressions which approximate well the differential cross sections obtained in the frames of the parton model are given for inclusive beauty hadron spectra produced in the hadron beam. The possibilities for the search of B-bar/sub S/ reversible B/sub S/-meson oscillations produced in the Σ^--hyperon beam by detecting decay leptons along the track are considered. The decay contribution of all the beauty B-mesons is shown to worsen considerably the possibility of the experiment, i.e., the expected error may exceed the measured value itself. 9 refs.; 3 figs.

38392 (INIS-mf—11223, pp 231-237) **Jet calculus beyond the leading log approximation.** Szymanowski, L. (Institute of Nuclear Research, Warsaw (Poland)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The jet calculus beyond leading log approximation is reviewed. New results on the gluon decay vertices are presented. 12 refs.

38393 (INIS-mf—11223, pp 261-269) **Comments on the EMC effect.** Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The scaling model and cluster model descriptions of the deep inelastic scattering structure functions are discussed. 14 refs.

38394 (INIS-mf—11223, pp 289-296) **Hard lepton scattering of quarks at finite density.** Bluemlein, J. (Akademie der Wissenschaften der DDR, Berlin-Zeuthen. Inst. fuer Hochenergiephysik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The structure function $F_3(x,Q^2)$ is discussed for lepton scattering of quarks at finite density at $Q^2 >> 1(GeVc)^2$. 10 refs., 3 figs.

38395 (INIS-mf—11223, pp 495-501) **Hadron instability and planar Regge trajectories.** Glushko, N.I.; Kobylinski, N.A.; Shelest, V.P.; Tutik, R.S. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki; Dnepropetrovskij Gosudarstvennyj Univ. (Ukrainian SSR)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

Hadronic spectrum is shown to be influenced by the resonance instability which should be taken into account when we reconstruct "bare" hadron spectrum or planar Regge trajectories. It was found that the spectrum of orbital excitations thickens at planar level. Some consequences of this fact are discussed. 7 refs., 2 figs., 1 tab.

38396 (INIS-mf—11223, pp 511-522) **Analytic pion form factor with higher rho resonances.** Dubnicka, S.; Martinovic, L. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

It is shown that is possible to reconstruct experimental behaviour of the pion form factor in the whole measured region -10 $GeV^2 < t < 10\ GeV^2$ within the model based on well-known analytic properties of the pion ff. The brief skech of such model in terms of parameters with clear physical meaning, which includes contributions of radially excited rho states and which is flexible in a choice of the asymptotic form is discussed. 17 refs., 3 figs., 1 tab. (M.F.W.).

38397 (INIS-mf—11223, pp 523-566) **Universal tadpole dynamics.** Scadron, M.D. (Arizona Univ., Tucson (USA). Dept. of Physics). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

Nonperturbative quark tadpole graphs are shown to drive strong, semistrong, electromagnetic, parity-violating weak and parity-conserving weak hadron dynamics. Almost fifty low energy hadron data are then predicted from four energy parameters, each of them having their origin in the quark model. Finally the Cabbibo angle is computed in terms of the semi-strong nonperturbative parameters. 60 refs., 21 figs.

38398 (INIS-mf—11223, pp 567-577) **Relativistic potential model for baryons.** Turski, A. (Warsaw Univ. (Poland). Inst. Fizyki Teoretycznej). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The possibility of extending the quark-diquark model to describe the excited nucleon states was investigated using the relativistic equations with spin. It was found that the simplest model doesn't work, except for correct predictions for the fine-structure splittings. The last result supports the use of the relativistic equations with spin for describing the spin-orbit interactions. 14 refs., 3 tabs.

38399 (INIS-mf—11223, pp 91-112) **Search for heavy spinless boson in electron-positron annihilation.** Brandt, S.; Dahmen, H.D. (Siegen Univ. (Gesamthochschule) (Germany, F.R.). Abt. fuer Physik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The cross sections for fermion- and photon pair production in $e^+ e^-$ annihilation through intermediate spinless bosons are discussed. Limits for the boson mass and its couplings are given as obtained in PETRA experiments. 15 refs., 8 figs.

38400 (INIS-mf—11223, pp 123-132) **Topics on the Lorentz structure of charged weak interactions.** Mursula, K. (Bern Univ. (Switzerland). Inst. fuer Theoretische Physik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

A brief summary of some theoretical and phenomenological topics related to the Lorentz structure of charged weak interactions is given. In particular the limits to some additional non-standard interactions and their implications are reviewed. A method to measure the chirality of the top quark in weak production is discussed and comment on the limits to right-handed currents from the neutrinoless double beta decay is made. 12 refs., 4 figs.

38401 (INIS-mf—11223, pp 133-142) **Can one observe one-loop effects in leptonic processes?.** Grzadkowski, B.; Pawelczyk, J. (Warsaw Univ. (Poland). Inst. Fizyki Teoretycznej). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The possibility of the experimental testing of the Glashow-Salam-Weinberg model at the one-loop level is investigated in leptonic processes. 7 refs., 2 figs., 3 tabs.

38402 (INIS-mf—11223, pp 143-161) **On the W and Q^2 dependence of fragmentation functions as measured in leptoproduction.** Schmitz, N. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Inst. fuer Physik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

Some problems and questions related to the W (hadronic effective mass) and Q^2 (four-momentum transfer) dependence of fragmentation functions as measured in leptoproduction are discussed. The main results obtained on this subject in previous experiments are reviewed. New data on νp and ν-barp scattering from a BEBC experiment suggest that in the present energy range fragmentation functions depend on W and (at fixed W) not on Q^2. The increase of particle production with increasing W seems to occur only at small Feynman-x/sub F/, i.e. in the central region, suggesting that it is mainly due to the kinematical widening of the available rapidity range with increasing W. 27 refs., 5 figs.

38403 (INIS-mf—11223, pp 377-386) **Search for supersymmetric particles in e^+e^- annihilation at PETRA.** Komamiya, S. (Heidelberg Univ. (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The possibilities of supersymmetric particles production in e^+e^- annihilation are studied. Since the mass spectra of supersymmetry are different from model to model, it is not easy to make searches in a model independent way. Hence mass limits themselves have no physical meaning unless assumptions are specified. The author tries to make clear what kind of assumptions has been made for each particle search. 9 refs., 13 figs., 2 tabs. (M.F.W.).

38404 (INIS-mf—11223, pp 177-187) **QCD effects in weak boson production.** Chiappetta, P. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The weak boson production is studied in perturbative QCD through the Drell Yan picture. A satisfactory agreement with UA1 and UA2 data is found. Predictions are also made at tevatron energies. 27 refs., 6 figs.

38405 (INIS-mf—11223, pp 201-207) **Can top be visible in CERN collider?.** Kurek, K. (Institute of Nuclear Research, Warsaw (Poland)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The estimates of the top quark production are made within a parton perturbative QCD model. The masses of the top quarks were taken into account in the kinematics and the evolution equations. The semileptonic weak decay of the heavy quark is considered as a possible signal of top flavour production. The number of events with high-p/sub T/ (>15 GeV) leptons from such decays is calculated for CERN collider. 22 refs., 1 fig.

38406 (INIS-mf—11223, pp 209-220) **Diquark scattering as a source of high p/sub T/ protons.** 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

As an additional source of large p/sub T/ protons in hard proton-proton interactions the scattering of valence diquarks is proposed. A quantitative analysis of the proposed mechanism is presented and the model calculations are compared with the data. 16 refs., 8 figs., 1 tab. (M.F.W.).

38407 (INIS-mf—11223, pp 331-336) **N-n-bar oscillations in nuclear matter.** Sanchez-Gomez, J.L. (Universidad Autonoma de Madrid (Spain)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

A treatment of n-n-bar oscillations in nuclear matter more complete than the optical model is presented. The expression for the nuclear annihilation width reduced per neutron is done. 7 refs., 2 figs. (M.F.W.).

38408 (INIS-mf—11223, pp 59-90) **Upper bounds on the Higgs mass (spectrum and mass formula in the Higgs sector).** Rodenberg, R. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

Using radiative corrections as the origin of spontaneous symmetry breaking (SSB), in the one- and in the two-loop approximation charged and neutral Higgs boson masses can be derived easily. Taking into account that B_0, a possible representant of the pseudotensor term, the axion a_0 and the supersymmetric U-boson belong to the same spectrum in the Higgs sector, experimental constrains allow to estimate m/sub H(sup 0)/ $<\sim$ 349 GeV and m/sub H(sup +-)/ $<\sim$ 125 GeV for a wide range of top quark masses of about 35 GeV $<\sim$ m/sub t/ $<\sim$ 80 GeV. 61 refs., 11 figs.

38409 (INIS-mf—11223, pp 387-398) **Recent work on chiral Lagrangians.** Golowich, E. (Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The concept of a chiral Lagrangian is briefly reviewed and several classical examples are presented. More recent work is then discussed, including applications to kaon and nucleon physics. The role of higher-order derivative couplings, loops and soliton solutions is stressed. 13 refs., 3 tabs.

38410 (ITEP—19(1987)) **Second Z-boson and electroweak mixing angle.** Polyakov, N.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702110/JAW.

The cross-section ratio of neutral-current neutrino scattering on nucleons in models with one (standard model) and two Z-bosons is calculated. Its value is found to be $\sim$ 1.15 for the mass m_2 of Z_2-boson being $m_2 \sim$ 200 GeV (the modern lower boundary for m_2). Obtained more severe restriction on m_2:m_2 >or approx. 500-700 GeV. 3 refs.; 4 figs.

38411 (ITEP—62(1987)) **Trinucleons as a multi-quark system.** Kalashnikova, Yu.S.; Narodetskij, I.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702890/JAW.

A new approach for investigation of the three-nucleon system is suggested in which it is assumed that the short-range interaction of nucleon clusters within trinucleons is described in terms of wave functions of virtual multiquark configuration. It is shown that the effective three-nucleon Hamiltonian contains the three-body forces arising from the dynamics of overlaping bags in the trinucleons. The latters, however, may be eliminated by a proper redifinition of the nucleon component in a nine-quark wave function. The integral equation for the three-nucleon wave function which has the form of the standard Faddeev equation but requires the phase-equivalent redefinition of the initial form of NN potential in the Quark Compound Bag method is derived. 19 refs.; 4 figs.

38412 (ITEP—77(1987)) On quantum correction to the Skyrmion mass. Eremeev, M.I.; Konoplich, R.V.; Kudryavtsev, A.E.; Martem'yanov, B.V.; Rubin, S.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702891/JAW.

Quantum correction to the "classical" nucleon mass is calculated taking into account radial fluctuations around the hedgehog Skyrme solution. The quantum correction pushes down the Skyrme-soliton mass if one choose the arbitrary mass scale of the theory M ~ m/sub rho/, where m/sub rho/ is the rho-meson mass. The nucleon and Δ-isobar mass difference is obtained correctly when the Lagrangian parameter E/sub π/=125 MeV. The value F/sub π/ is in a better agreement with pion-decay constant F/sub π/=186 MeV than the value F/sub π/=108 MeV that was obtained previously in the framework of the Skyrme model without the consideration of the vibrational quantum corrections. 12 refs.; 2 figs.; 1 tab.

38413 (ITEP—79(1987)) Multibaryon masses in quark models: quark potential model versus bag model. Kalashnikova, Yu.S.; Narodetskij, I.M.; Simonov, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702113/JAW.

A quasiclassical approximation in the hyperspherical formalism is applied to calculate the spectra of some 6q, 9q and 12q states in the quark potential model (QPM). The quasiclassical approximation is shown to lead to very accurate predictions for the masses of multiquark states. The significant difference in the predictions for masses of multiquark states in the QPM and bag model (400 MeV for 6q, 800 MeV for 9q and 1400 MeV for 12q) is shown to be due to the faster increase of the multiquark potential energy in the QPM and may be removed if the confining potential damps at small distances. 28 refs.; 3 figs.; 8 tabs.

38414 (ITEP—85(1987)) Higher twist effects in QCD description of light meson exclusive formfactors. 1. General approach and twist 3 wave functions. Gorskij, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702892/JAW.

The general approach to a quantitative description of higher twist effects in hard exclusive processes in QCD is proposed. The consistent calculations in coordinate space and the choice of special gauges for quantum and classical gluon fields are essential ingradients of this method. The self consistent system of twist three wave functions for π-meson has been built. 28 refs.; 7 figs.

38415 (ITEP—148(1987)) Neutrino magnetic moment in a theory with lepton flavor symmetry. Stephanov, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702893/JAW.

A model for generating the neutrino magnetic moment of the order of 10^{-10} μ/sub B/ is proposed, which is based on the SU(3) lepton flavor symmetry. In such a way one can avoid the flavor changing processes. The experimental constraints on the constants of the model are considered. 6 refs.; 1 fig.

38416 (ITEP—158(1987)) Strange diquarks and orbital excitations of hyperons. Kondratyuk, L.A.; Ralchenko, Yu.V.; Vasilets, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702894/JAW.

Using the model of the QCD string with spin-orbital interaction the masses of strange diquarks are determined. The spectra of orbital excitations of the Λ and Σ hyperons are calculated and discussed. Also the decay modes for Λ's and Σ's are considered. 11 refs.; 5 figs.

38417 (ITP—87-3) Correlation between dilepton emission and hadronic multiplicity in ultrarelativistic nuclear collisions as the signal of a deconfinement phase transition. Gorenstein, M.I.; Pavlenko, O.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702898/JAW.

In scaling-hydrodynamic model for ultrarelativistic nuclear collisions the correlation between lepton pair emission and hadronic multiplicity is studied in central rapidity region. The sharp increase in dilepton emission with hadronic multiplicity is the signal of quark-hadron mixed phase formation. 10 refs.; 1 fig.

38418 (JINR—E-2-87-483) Wide scalar gluonium and the quark-antiquark scalar nonet. Lanik, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702433/JAW.

Submitted to the journal Zeit. Phys., C.

The couplings of scalar gluonium as well as quark-antiquark scalar nonet states to the pseudoscalar mesons are discussed on the basis of the low-energy theorems of broken chiral symmetry and scale invariance implemented using phenomenological Lagrangian. Mixing between pure gluonium σ and the SU(3)/sub F/ singlet quarkonium S_0 is considered. Taking for the mases of S_0 and σ the values based on estimates of the quark model and of recent QCD lattice calculations, respectively, and using the "standard" values of the gluon condensate, the mixture of S_0 and σ in the physical states G and ϵ is predicted to be approximately half-and-half. G is predicted to have properties consistent with the $F_0(1590)$ meson, while ϵ is predicted to be the wide effective gluonium state below 1 GeV. On this basis it is suggested that a possible consistent description of the whole scalar qq-bar nonet. The picture contains S*(975) neither as qq-bar nor as qq state and thus still more exotic interpretation of the S*(975) effect is supported. 33 refs.

38419 (JINR-E—2-87-355) Cumulative hadron production in quark models of flucton fragmentation. Efremov, A.V.; Kim, V.T.; Lykasov, G.I.; Slavin, N.V.; Kaidalov, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702906/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Quark models of cumulative particle production and the EMC-effect are analyzed. It is shown that all these models are characterized by universal relation of the cumulative nucleon spectrum with the production cross section of cumulative particles containing nuclear valence quarks. testing of this relation for a deuteron is carried out and the role of secondary nuclear processes for heavy nuclei is discussed. Special role of "sea" cumulative particles (K^-, p-bar) for understanding the nature of the EMC-effect is discussed. 43 refs.; 5 figs.

38420 (JINR-E—2-87-370) Calculation of moments of structure function of deep inelastic scattering in QCD. Kotikov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702907/JAW.

Submitted to the journal Theor. Math. Phys. .

The method of uniqueness is applied to calculate the moments of structure functions of deep inelastic scattering in QCD. Examples are given of calculations of multiloop diagrams which depend on two momenta, when the square of one of them equals zero. The method can be used in other theories where Wilson's operator product expansion is applied. It can also be used to calculate propagator-type diagrams with a large number of momenta in lines. 11 refs.; 7 figs.; 1 tab.

38421 (JINR-E—2-87-543) Deep inelastic scattering in the formalism with the wave functions of composite systems at rest. Khvedelidze, A.M.; Kvinikhidze, A.N.; Sisakyan, A.N. (AN Gruzinskoj SSR, Tbilisskij Matematicheskij Inst.; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702908/JAW.

Submitted to the journal Z. Phys. .

A deep inelastic process of lepton-hadron scattering is studied in the bound-state rest frame. A new version of expansion of structure functions over an interaction constant is proposed, each term in it having spectral properties. It is shown that the impulse approximation is insufficient for a correct description of the elastic limit in the composite particle rest frame in contrast with the system of infinite momentum P/sub Z/ -> ∞. The leading asymptotics of the structure functions as x/sub Bj/ -> 1 can be obtained by allowing for the interaction of consituents in a final state. Using as an example a bound state ot two and three particles it is shown that the results of calculations of the relevant diagrams in the QCD model are in agreement with those obtained in th formalism P/sub Z/ -> ∞. 9 refs.; 4 figs.

38422 (JINR-E—2-87-548) P-barp annihilation in the dual parton model and perturbative QCD. Kopeliovich, B.Z.; Zakharov, B.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; AN SSSR, Moscow. Inst. Fiziki Zemli). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702909/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

In the framework of perturbative QCD the contribution to the annihilation cross section resulting from exchange of two gluons in the colour decuplet state is calculated. The result depends essentially on the diquark radius, and is equal to 1-2 mb. This contribution slightly varies with energy and dominates the annihilation cross section in the asymptotics. The preasymptotical mechanism of annihilation is also considered which causes fast decrease in the cross section with energy ($\sim 1/\sqrt{E}$) at the intermediate energies E < 12 GeV. 41 refs.; 8 figs.

38423 (JINR-R—2-87-450) Relativistic operator quantization and confinement in QCD. Pervushin, V.N.; Nguyen Suan Han. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702927/JAW.

Submitted to the journal Int. J. Modern Phys., A.

A new (nonpotential) mechanism of confinement for the foundation of the local quark-hadron duality principle is considered. This mechanism may be realized in the scheme of quantization of the gauge theories with the explicit solution of the Gauss equation and dynamic fixed gauge, where relativistic transformations of classical and quantum fields coincide. Theoretical and phenomenological arguments of separating the confinement from dynamics of the hadronization are discussed. 27 refs.

38424 (LA-UR—88-1494) The nucleon as a pionic nontopological soliton or beyond the cloudy bag model. Bolsterli, M.; Parmentola, J.A. (Los Alamos National Lab., NM (USA); West Virginia Univ., Morgantown (USA)). 1988. Contract W-7405-ENG-36. 11p. (CONF-880560—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010953/JAW.

From Topical conference on nuclear quantum chromodynamics; Argonne, IL, USA (19 May 1988).

This paper describes the Los Alamos soliton model of the nucleon that was developed in order to incorporate core motion into the cloudy-bag model of the nucleon.

38425 (LAPP-TH—201-87) Vertex operator representation of OSp(M/N). Frappat, L. (Annecy Univ., 74 (FR)). (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Sep 1987. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753970/JAW.

Using the boson-fermion equivalence in 2-d conformal field theory and the boson-boson equivalence of the superconformal bosonic ghost fields of the string theory, we construct a level k = +1 representation of the affine superalgebra OSp (M/N) in terms of vertex operators.

38426 (LBL—25247) Jet physics in e^+e^- annihilation: evidence for the running of α_s. Bethke, S. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 11p. (CONF-880399—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012015/JAW.

From 23. Rencontre de Moriond: current issues in hadron physics; Les Arcs, France (13 Mar 1988).

The energy dependence of the relative production rate of 3-jet events is studied in hadronic e^+e^- annihilation events at centre of mass energies between 22 and 56 GeV, using the data of the JADE, MARK-II and AMY collaborations at PETRA, PEP and TRISTAN. Three jet events are defined by a jet finding algorithm which is closely related to the definition of resolvable jets used in $O(\alpha_s^2)$ perturbative QCD calculations, where the relative production rate of 3-jet events is roughly proportional to the strong coupling strength, α_s. The observed production rates of 3-jet events decreases significantly with increasing centre of mass energy. The results, which are independent of fragmentation model calculations, can be directly compared to theoretically calculated jet production rates and are in good agreement with the QCD expectations of a running coupling strength, while the hypothesis of an energy independent coupling constant can be excluded with a significance of 5 standard deviations. Based on these results, the presented jet analysis also provides the possibility to detect first signs of the production of new and heavy particles in the early stage of data taking at SLC and LEP.

38427 (LPC—86-03) P/sub T/ and Q^2 dependence of multijet production in $\gamma\gamma^*$ collisions/sup +)/. Arteaga-Romero, N.; Carimalo, C.; Kessler, P. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). Mar 1986. 23p. (CONF-8604238—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753487/JAW.

From 7. international workshop on photon-photon collisions; Paris, France (1 Apr 1986).

In the context of a measurement recently performed by the PLUTO Collaboration at PETRA, we have computed the contribution of 2-jet, 3-jet and 4-jet production processes (each involving 2 large-P/sub T/ jets) in $\gamma\gamma^*$ collisions to the differential cross section $d\delta(dp/sub\ T/dQ^2)$, where Q^2 is the γ^*'s four momentum squared. It results that the total correction to the 2-jet contribution ($\gamma\gamma^*$->qantiq), obtained for P/sub T/ and Q^2 values located in the range 2 GeV<P/sub T/<6 GeV and 0.1 GeV^2<Q^2<12 GeV^2 varies rather slowly as a function of those two parameters; it ranges between 30% and 70%. The specific contribution of the higher twist term involving the process $\gamma\gamma^*$->Mqantiq appears to be insignificant. The discrepancy observed between experiment and theory at $Q^2 < \sim 0.3$ GeV^2 and P/sub T/$\sim$=2 - 3.5 GeV is not explained by our results.

38428 (LYCEN—8721) Motion of a particle in a Coulomb plus Aharonov-Bohm potential. Kibler, M.; Negadi, T. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). May 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753489/JAW.

The motion of a particle in a Coulomb plus Aharonov-Bohm potential is investigated from a classical and a quantum mechanical viewpoint. The quantum bound states are derived by using the KS transformation. The grouping of certain levels is explained via the introduction of a SU(2) dynamical algebra. All classical finite trajectories are found to be periodic.

38429 (OUP—87-34) Comment on "Discrepancy between theory and experiment for λ e^+ -> $\lambda e^+\nu$: Possible evidence for a fourth generation". Hoegaasen, H.; Lie-Svendsen, Oe. (Oslo Univ. (Norway). Fysisk Inst.). Oct 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752494/JAW.

A caluculation of the weak decay $\lambda c^+ \rightarrow \lambda e^+ \nu$ in the MIT bag model is presented. It is demonstrated that the result is compatible with observation.

38430 **(SLAC-PUB—4601) Theory of e⁺e/sup {minus}/ collisions at very high energy.** Peskin, M.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1988. Contract AC03-76SF00515. 45p. (CONF-870821—12). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010682/JAW.

From SLAC summer institute on particle physics: looking beyond the Z; Stanford, CA, USA (10 Aug 1987).

In these lectures, the array of new phenomena are reviewed which might be discovered in electron-positron reactions conducted at energies well above the Z{degree}. Before beginning a discussion of what new phenomena we might find, or how we might uncover them, the question is addressed of why such a program of research is important. The question of what we should be looking for, and what discoveries will be the most illuminating, as we search for the next layer of fundamental physics is argued. With this background, we can then discuss in some considerable detail the contributions that the study of electron-positron collisions at high energy can make in this search.

38431 **(SLAC-PUB—4604) B-factories.** Bloom, E.D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1988. Contract AC03-76SF00515. 19p. (CONF-871071—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010678/JAW.

From 8. Vanderbilt high energy physics conference; Nashville, TN, USA (8 Oct 1987).

We briefly review the physics of CP violation and the interest of studying this phenomenon in the B-meson system. The need for very large numbers of B-decays is shown, and a number of approaches for B-factories are compared. In particular, e⁺e/sup {minus}/ linear and circular colliders are discussed in some detail, with specific examples presented. 31 refs., 22 figs., 5 tabs.

38432 **(TRI-PP—88-17) Relativistic treatment of mesonic contributions to quasielastic (e,e').** Blunden, P.G.; Butler, M.N. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1988. 7p. (CONF-880386—4). NTIS (US Sales Only), PC A02/MF A01;1; GPO Dep. Order Number DE88010868/JAW.

From International conference on spin-observables in nuclear physics; Telluride, CO, USA (14 Mar 1988).

A relativistic model with pseudovector pion coupling is used to study exchange current contributions, with emphasis on quasielastic kinematics, beginning with the Lagrangian for nucleons interacting with a scalar and vector meson. It is found that the effects of meson-exchange currents are more important in a relativistic model than in a non-relativistic one.

38433 **Left-right symmetry and neutrino masses in a nonperturbative unification framework.** Hung, P.Q.; Mohan, S. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review Letters;* **61**: No. 1, 31-34(4 Jul 1988).

Within the nonperturbative unification framework pioneered by Maiani, Parisi, and Petronzio, it is shown how the mass of the right-handed W boson can be determined just by knowledge of the values of $\sin^2\theta$/sub W/ and α_s (equivalentg$_s^2/4\pi$) at the Fermi scale Λ/sub F/$\simeq$250 GeV. It is found that M/sub W//sub >//sub R/ can be as low as 8 TeV and, as a consequence, it may be possible to detect W/sub R/ at the proposed Superconducting Super Collider. In the model considered here, light, Majorana neutrino masses are found to be small (<65 eV).

38434 **Measure of CP nonconservation and its consequence on the structure of the Kobayashi-Maskawa matrix.** Hamzaoui, C. (Department of Physics, The Rockefeller University, 1230 York Avenue, New York, New York 10021). *Physical Review Letters;* **61**: No. 1, 35-37(4 Jul 1988).

By use of unitarity of the Kobayashi-Maskawa matrix, the rephasing-invariant measure δ/sub KM/ of CP nonconservation is evaluated in terms of the modulus squared of four matrix elements, which are taken as the four independent parameters. The striking feature of such a formulation is that the positivity of δ/sub KM/^{2} gives both upper and lower bounds on the matrix elements chemical bondV/sub c//sub d/chemical bond, chemical bondV/sub c//sub s/chemical bond, chemical bondV/sub t//sub d/chemical bond, and chemical bondV/sub t//sub s/chemical bond.

38435 **Nonperturbative unification in the manner of Maiani, Parisi, and Petronzio at intermediate energies.** Hung, P.Q. (Fermi National Accelerator Laboratory, Post Office Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **38**: No. 1, 377-382(1 Jul 1988).

A nonasymptotically free gauge theory with many couplings is shown to exhibit a "trapping" mechanism, in the sense that, as soon as one (or more) of the couplings grows large, the rest of the couplings will follow suit. This mechanism can help achieve a nonperturbative "unification" of the standard model in the manner of Maiani, Parisi, and Petronzio at relatively "low" energies (TeV scales). Two scenarios are given, one of which is just the standard SU(3)/sub c/ x SU(2)/sub L/ x U(1)/sub y/ and the other one involves, in addition, technicolor interactions. Predictions for $\sin^2\theta$/sub w/(Λ/sub F/$\simeq$250 GeV) and $\alpha_s(\Lambda$/sub F/) are presented for both scenarios. Both scenarios make use of SU(2)/sub L/-singlet heavy fermions which carry charge, color (model I), and technicolor (model II). Some experimental implications are also discussed.

38436 **Relativistic theory of the decay of upsilon into Higgs boson + photon.** Faeldt, G.; Osland, P.; Wu, T.T. (Gustaf Werners Institut, Box 531, S-751 21 Uppsala, Sweden). *Physical Review [Section] D: Particles and Fields;* **38**: No. 1, 164-213(1 Jul 1988).

We present a technique for calculating the decay rate for quarkonium→Higgs boson+photon. It is applied to upsilon decay into a Higgs boson of mass in the range 7—9 GeV. Relativistic effects are accounted for by employing Bethe-Salpeter equations to determine the Ybb-bar and Hbb-bar vertex functions. The decay rate is controlled by two amplitudes that interfere destructively. It is found that the ratio $\Gamma(\Upsilon\rightarrow H\gamma)/\Gamma(\Upsilon\rightarrow\mu^+\mu^-)$ is substantially smaller than that of nonrelativistic calculations.

38437 **Radiative-induced fermion masses.** Chang, D.; Liu, J. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208). *Physical Review [Section] D: Particles and Fields;* **38**: No. 1, 327-331(1 Jul 1988).

Gauge models in which fermion masses are generated radiatively are discussed. Conditions under which it may be achieved naturally are presented. An example of such models is illustrated in the context of SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge theory.

38438 **Cosmic-ray neutrinos in the atmosphere.** Gaisser, T.K.; Stanev, T.; Barr, G. (Bartol Research Institute, University of Delaware, Newark, Delaware 19716). *Physical Review [Section] D: Particles and Fields;* **38**: No. 1, 85-95(1 Jul 1988).

In this paper we give a complete account of detailed calculations of the flux of neutrinos of atmospheric origin that we have made for detectors at various locations on the globe. The emphasis here is on neutrinos in the energy range around 1 GeV, and we compare the results with recent measurements made with larger underground detectors. A detailed knowledge of the atmospheric cosmic-ray neutrino flux is a prerequisite for evaluating the background for the search for nucleon decay as well as the background for neutrinos of extraterrestrial origin.

38439 **W^+W^- pair production at resonances in the SU(2)/sub L/ x SU(2)/sub R/ x U(1) model.** Rajpoot, S.; Samuel, M. (Department of Physics, Oklahoma State University, Stillwater, Oklahoma 74078). *Physical Review [Section] D: Particles and Fields;* **38**: No. 1, 391-393(1 Jul 1988).

Consistent with all neutral-current data, the mass of the second neutral gauge boson of the SU(2)/sub L/ x SU(2)/sub R/ x U(1) electroweak interaction model can be as low as 240 GeV. It is shown that if the second neutral boson mass turns out to be in the 1-TeV range, its production and subsequent decay at resonance offers the exciting possibility of copiously pair producing the

charged weak gauge bosons of the standard SU(2)/sub L/ x U(1) model.

38440 Stochastical dynamics and charge conservation in hadronization. Shih, C.C.; Carruthers, P. (Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37996-1200). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 1, 56-63(1 Jul 1988).

Stochasticity in multiplicity distribution of total inelastic hadronic distributions is investigated in conjunction with the requirement of charge conservation. We obtain, for the simplest quantum-mechanical systems, neutral cluster states or partially coherent charged states. While neutral cluster states lead to negative-binomial distributions, partially coherent charge states lead to distributions very similar to the ordinary partially coherent states. Charge-compensation mechanisms are very different for these extremes. In terms of neutral clusters, the hadron multiplicity fluctuation is too large for e^+e^- systems, but is compatible to hadron-hadron systems at high energies. In terms of partially coherent charge distributions, the ratio of coherence to chaos is large for the e^+e^- systems and rather small for the hadron-hadron systems, similar to the conclusion obtained through the partially coherent laser distributions. Simple consequences of charge correlations and compensation in a restricted region of the phase space is also investigated.

38441 High-energy nucleon-nucleus scattering and cosmic-ray cross sections. Durand, L.; Pi, H. (Department of Physics, University of Wisconsin—Madison, Madison, Wisconsin 53706). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 1, 78-84(1 Jul 1988).

We develop a QCD-based diffractive model for nucleon-nucleon and nucleon-nucleus cross sections in which the increase in the cross sections at high energies is driven by semihard parton-parton scattering. We use the model to calculate the absorptive cross section for protons on air at very high energies, and find excellent agreement with data from cosmic-ray experiments. The results can be used to extract σ/sub tot/(pp) from σ/sub abs/(p-air) in a way which is nearly independent of the input parameters. We include an approximate treatment of single-diffractive pp scattering.

38442 Nonlinear effects in the flux-tube model for ultrarelativistic nucleus-nucleus collisions. Gatoff, G.; Kerman, A.K.; Vautherin, D. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 1, 96-104(1 Jul 1988).

We solve the classical Yang-Mills equations numerically for the evolution of the color fields in the flux-tube model for ultrarelativistic collisions. We show that nonlinear effects are small and decrease as the nuclei recede. This result can be understood in the limit of large background fields from an analytic study of the linearized equations.

38443 Interference effects and the longitudinal fraction in the process gg→ZZ. Dicus, D.A. (Center for Particle Theory, University of Texas, Austin, Texas 78712). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 1, 394-397(1 Jul 1988).

The contribution to pp→ZZ+X from gluon fusion (gg→ZZ) is determined and combined with the contributions from the subprocesses qq-bar→ZZ, WW→ZZ, and ZZ→ZZ to find the total Higgs-boson signal in ZZ production and the fraction of events where the Z's are longitudinal.

38444 Graphic evidence for non-Abelian flux tubes. Caldi, D.G.; Sterling, T. (Department of Physics, University of Connecticut, Storrs, Connecticut 06268). *Physical Review Letters;* **60**: No. 24, 2454-2457(13 Jun 1988).

From Monte Carlo calculations of plaquette—Wilson-loop correlations for three-dimensional SU(2) lattice gauge theory, we give unambiguous graphic demonstrations of the formation of non-Abelian chromoelectric flux tubes with constant energy density in the region between a pair of static qq-bar sources.

38445 Average temperature and multiplicities of e^+e^- annihilation. Hoang, T.F.; Cork, B. (Lawrence Berkeley Lab., CA (USA)). *Zeitschrift fuer Physik* [*Sektion*] *C: Particles and Fields;* **38**: No. 4, 603-607(May 1988). Contract AC03-76SF00098.

Hadron temperatures of e^+e^- -> hanti h from PEP experiments at 29 GeV are estimated using the P/sub perpendicular/ /sub to/ distribution: rather small fluctuations are found for temperatures of π, K, ..., γ with respect to the average anti T = 196+-7 MeV. A semi-empirical formula including quark content of h is proposed to account for multiplicities of π, K, ..., Ω in terms of a unique temperature anti T. The formula is further extended to charmed particles D, F, Jpsi and Λ/sub c/ without free parameters. The property anti T proportional to E/sub cm/^{1}4 holds for other experiments of DESY and CESR.

38446 Phenomenology and conformal field theory or can string theory predict the weak mixing angle?. Banks, T.; Dixon, L.J.; Friedan, D.; Martinec, E. (California Univ., Santa Cruz (USA). Inst. for Particle Physics; California Univ., Santa Cruz (USA). Dept. of Physics; Stanford Linear Accelerator Center, CA (USA); Chicago Univ., IL (USA). Enrico Fermi Inst.; Chicago Univ., IL (USA). Dept. of Physics). *Nuclear Physics* [*Section*] *B;* **299**: No. 3, 613-626(11 Apr 1988). Contract AC03-76SF00515;AM03-76SF00010;FG02-84ER45144;AC02-80ER10587.

We show that the weak mixing angle Θ/sub w/ is the same for continuously connected classical vacua of the beterotic string which have chiral fermions in their massless spectra. We also show that the world-sheet quantum field theory for any classical vacuum with spacetime supersymmetry possesses an N=2 superconformal invariance.

38447 Planar and non-planar Wilson loops in QCD. Bagan, E.; Latorre, J.I. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.; Massachusetts Inst. of Tech., Cambridge (USA). Center for Theoretical Physics; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). *Nuclear Physics* [*Section*] *B;* **298**: No. 3, 613-635(14 Mar 1988). Contract AC02-76ER03069;AC02-76CH00016.

A general QCD sum rule calculation of vacuum expectation values of Wilson loops is presented and particularized to several specific planar and non-planar contours. The string tension obtained is $\sqrt{\sigma}$ = 0.50(5) GeV. Within the errors of the approach, this result is shape-independent. We comment on the possibility that corrections to the area and perimeter laws could be parametrized by a geodesic curvature term.

38448 Probing lepton structure at the SSC. Chivukula, R.S.; Randall, L. (Boston Univ., MA (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)). *Physics Letters* [*Section*] *B;* **202**: No. 3, 429-435(10 Mar 1988). Contract AC03-76SF00098;AC02-86ER40284.

If quarks and leptons are composite objects with common constituents, then there exist two-quark-two-lepton contact interactions which could affect lepton pair production at the SSC. We show that for a range of compositeness scales and lepton pair invariant masses, the contact interaction contributions dominate the standard model contributions to the cross section. In this regime, we show that there should be a measurable and statistically significant front-back asymmetry.

38449 Technichiral color and the generation structure. Kuo, W.C.; Slaven, D.; Young, B.L. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). *Physics Letters* [*Section*] *B;* **202**: No. 3, 353-357(10 Mar 1988). Contract W-7405-ENG-82.

We generalize a recently proposed chiral color model to a technicolor theory. This generalization has two interesting features: (a) The generation number of the ordinary quarks is determined by the technicolor group structure. (b) The technifermion condensates break both the chiral color and the electroweak symmetries. We also consider cases of slowly running coupling for the technicolor interaction.

38450 **Baryon masses in the bound state approach to strangeness in the Skyrme model.** Callan, C.G.; Hornbostel, K.; Klebanov, I. (Princeton Univ., NJ (USA). Joseph Henry Labs.; Stanford Linear Accelerator Center, CA (USA)). *Physics Letters* [*Section*] *B;* **202**: No. 2, 269-275(3 Mar 1988). Contract AC03-76SF00515;AC02-76ER03072.

We diagonalize exactly the O(N/sub c/°) hamiltonian relevant to the bound state approach to strangeness in the Skyrme model. The hyperfine splittings of strange baryons computed within this framework agree well with the experimental values.

38451 **Weak radiative B-meson decay as a probe of the Higgs sector.** Grinstein, B.; Wise, M.B. (Lawrence Berkeley Lab., CA (USA); California Inst. of Tech., Pasadena (USA);). *Physics Letters* [*Section*] *B;* **201**: No. 2, 274-278(4 Feb 1988). Contract AC03-76SF00098;AC03-81ER40050;FG03-84ER40172.

We examine the rate for B-meson decay to a hard photon and strange hadronic final states (i.e., B -> γX/sub s/, X/sub s/ = K/sup */, etc) in extension of the standard model with two Higgs doublets and no tree-level flavor-changing neutral Higgs-boson couplings. In such models the rate for B -> γX/sub s/ can differ dramatically from what it is in the standard model.

38452 **Tadpole in the chiral Lagrangian of K decays.** Leurer, M. (Lawrence Berkeley Lab., CA (USA);). *Physics Letters* [*Section*] *B;* **201**: No. 1, 128-132(28 Jan 1988). Contract AC03-76SF00098.

We prove that when the chiral lagrangian is expanded to first order in G/sub F/ and to any finite order in meson masses and momenta the tadpole can be completely rotated away, namely: the tadpole is not physically observable.

38453 **Gluon propagator at finite temperature.** Mandula, J.E.; Ogilvie, M. (USDOE, Washington, DC; Washington Univ., St. Louis, MO (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA);). *Physics Letters* [*Section*] *B;* **201**: No. 1, 117-122(28 Jan 1988). Contract AC02-76CH00016.

The Landau gauge gluon propagator at finite temperature above and below the deconfinement transition is measured using lattice Monte Carlo simulation. The color electric and magnetic masses are determined. The most striking result of the calculation is that the time component of the gluon field appears to acquire a vacuum expected value in the deconfined region.

38454 **Summary of tritium beta spectrum studies.** Roberston, R.G.H. (Los Alamos National Lab., NM (USA)). pp 2 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Neutrinos were created in vast numbers during the big bang and now fill the universe. They so outnumber nucleons that if they have even a tiny mass, about 10^{-4} of the electron mass, they would dominate the mass of the universe and prevent it from expanding indefinitely. In 1980 a Russian experimental team studying the beta decay of tritium reported that the electron (anti)neutrino had a mass of 35 eV, just about right to close the universe. Many groups around the world set out to check this result, and some new data are now available. They will report on the new results from ITEP (Moscow), Zurich, Los Alamos, Tokyo, and elsewhere.

38455 **Color response and color transport in a quark-gluon plasma.** Heinz, U. (Physics Dept., Brookhaven National Lab., Upton, NY 11973 (US)). pp 466-484 of Hadronic matter in collision: Proceedings of the second international workshop on local equilibrium in strong interaction physics. Carruthers, P.; Strottman, D. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860440—). Contract AC02-76CH00016.

From 2. international workshop on local equilibrium in strong interaction physics: hadronic matter in collision; Santa Fe, NM, USA (9 Apr 1986).

Using color kinetic theory, the authors discuss color conduction and color response in a quark-gluon plasma. Collective color oscillations and their damping rates are investigated. An instability of the thermal equilibrium state in high T QCD is discovered.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 38388, 38389, 38409, 38437, 38604, 38606, 38607

38456 (INIS-BR—1018, pp 29) **Supersymmetry and the accidental degeneneration.** Jayaraman, J.; Lima Rodrigues, R. de. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38457 (INIS-BR—1018, pp 30) **Spectrum of orbital angular momentum with the supersymmetry algebra.** Jayaraman, J. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38458 (INIS-BR—1018, pp 30) **From classical mechanic to supersymmetry.** Vasconcelos, G.L. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38459 (INIS-BR—1075, pp 6) **Conformal invariance in statistical mechanics and field theory.** Kurak, V. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38460 (INIS-BR—1075, pp 12) **Renormalization by generalized minimum subtraction.** Barbosa, M.C.B.; Gusmao, M.A.C.; Theumann, W.K. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38461 (INIS-BR—1075, pp 12) **Chaos in generalized asymmetric one mode mapping.** Vieira, M.C.S.; Nunez, E.L.; Tsallis, C. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38462 (INIS-mf—11219, pp 135-146) **Group contractions, the RPA and symmetries.** Scholtz, F.G.; Hahne, F.J. (Institute of Theoretical Nuclear Physics, University of Stellenbosch, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

Using the concept of group contractions we discuss the implications of the RPA for the dynamical group as well as symmetry groups of finite boson systems. In particular it is shown that if the Hartree-Bose ground-state breaks the symmetry, the RPA contracts

the symmetry group onto a non-semisimple group which is a symmetry group of the RPA Hamiltonian. This group contains all subgroups of the original symmetry group which are not broken by the ground-state. The abelian invariant subalgebra of the contracted algebra contains the excitation operators of the spurious modes.

38463 Construction of classical Virasoro algebras as SU(1,1) extensions. Fairlie, D.B.; Nuyts, J.; Zachos, C.K. (Durham Univ. (UK). Dept. of Mathematics; Mons Univ. (Belgium). Dept. de Physique; Argonne National Lab., IL (USA). High Energy Physics Div.). *Physics Letters [Section] B;* 202: No. 3, 320-324(10 Mar 1988). Contract W-31-109-ENG-38.

The generators of SU(1,1) and their Casimir invariant may be arrayed in a compact formula to construct all generators of the centreless Virasoro algebra which includes this SU(1,1) subalgebra. We illustrate properties of our construction through a simple differential operator realization of these algebras and comment on its usefulness.

38464 Dynamical symmetry breaking, axion dynamics and instanton-induced second-class tau-decays. White, A.R. (High Energy Physics Div., Argonne National Lab., Argonne, IL (US)). *Modern Physics Letters A;* 2: No. 12, 945-956(Dec 1987). Contract W-31-109-ENG-38.

Small color instantons, which have been proposed as a mechanism to raise the axion mass, may also produce a large rate for the second-class tau-decay mode tau $\rightarrow \pi\eta\alpha\nu$. The growth of the QCD coupling and large anomalous dimension scaling properties needed are natural consequences of dynamical electroweak symmetry breaking by color sextet quarks.

38465 The phenomenological analysis of hadronic multiplicity distributions. Carruthers, P.; Shih, C.C. (Dept. of Physics, Univ. of Arizona, Tucson, AZ 85721 (US)). *International Journal of Modern Physics A;* 2: No. 5, 1447-1548(Oct 1987).

The aims of the present paper are limited to a description of theoretical and phenomenological techniques which are, as far as possible, model independent, or at least valid for a class of models. It is the authors' experience that most of the gross measures of particle reaction data (e.g. total cross sections, inclusive distributions, KNO "plots," etc.) do not discriminate among models unless supplemented with more fine grained information, especially correlations of various kinds. In the absence of a quantitative theory for the exclusive matrix elements, from which all else follows, it seems more constructive to work from the outside to the inside. (An especially powerful tool for this is intensity interferometry, much used in the statistical theory of optics but as yet rather undeveloped for the analysis of elementary particle data.) Whenever possible we emphasize the statistical essence of an observable, which can be rather independent of the particular dynamical process. A familiar example is the Maxwellian energy distribution of gas molecules in thermal equilibrium, whose form (as does the validity of hydrodynamic equations for the system) is independent of the detailed force law. This example illustrates both the strength and weakness of the approach.

38466 From baryon number generation to the quark-hadron phase transition. Snyderman, N.J. (Lawrence Livermore National Lab., CA (USA)). pp 1 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-7405-ENG-48.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Between the temperature scale at which baryon number was generated and the temperature at which baryons and mesons formed, there were phase transitions associated with the Weinberg-Salam symmetry breaking, and perhaps with Pecci-Quinn symmetry breaking and supersymmetry breaking. Also, the quark-hadron phase transition may have taken place in the presence of cosmic strings. Some possible consequences of these phase transitions and degrees of freedom on the quark-hadron phase transition will be discussed.

38467 Quark-hadron phase transition and primordial baryon diffusion. Fuller, G.M.; Mathews, G.J.; Alcock, C. (Lawrence Livermore National Lab., CA (USA)). pp 1 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract W-7405-ENG-48.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

The authors compute the maximum amplitude for isothermal baryon number density fluctuations to emerge from the quark-hadron phase transition and their effects on primordial nucleosynthesis, as a function of the coexistence temperature and the fractional volume of the universe which will remain in quark-gluon plasma when the release of latent heat no longer compensates the cooling due to expansion. In a universe with Omega = 1 in baryons, they find that ^{4}He, ^{3}He, and deuterium are within observed constraints for a large part of the parameter space. However, ^{7}Li is overproduced. They find only a very small abundance of elements heavier than mass 11 (total mass fraction $X \leqq 10^{-8}$).

6454 Field Theory

REFER ALSO TO CITATION(S) 38397, 38398, 38433, 38442, 38444, 38459, 38604, 38605, 38664, 38736

38468 (CEA-CONF—9313) Scattering and short-distance properties in field theory models. Iagolnitzer, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). 1987. 12p. (CONF-8709280—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753472/JAW.

From Conference on mathematical quantum field theory and related topics; Montreal, Canada (1 Sep 1987).

The aim of constructive field theory is not only to define models but also to establish their general properties of physical interest. We here review recent works on scattering and on short-distance properties for weakly coupled theories with mass gap such as typically P(phi) in dimension 2, phi^4 in dimension 3 and the (renormalizable, asymptotically free) massive Gross-Neveu (GN) model in dimension 2. Many of the ideas would apply similarly to other (possibly non renormalizable) theories that might be defined in a similar way via phase-space analysis.

38469 (DOE/ER/40125—14) Theoretical particle physics: Technical progress report. Gottlieb, S.A. (Indiana Univ., Bloomington (USA). Dept. of Physics). May 1988. Contract AC02-84ER40125. 42p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011499/JAW.

Research in lattice gauge theory during the past year is described. Several projects were completed dealing with QCD simulations including dynamical fermions. A study of the spectrum of QCD was combined with a study of the finite temperature chiral symmetry restoration transition in order to determine the transition temperature in MeV. The transition temperature is seen to be ~ 130 MeV, which makes it more accessible to observation at a relativistic heavy-ion collider than previously expected. Studies of hadronic screening lengths and the quark number susceptibility at zero chemical potential provide further probes of the high temperature phase of QCD. Work has continued on algorithm development with the publication of one paper on systematic errors as a function of step size and conjugate gradient residual, and work in progress on fermion matrix preconditioning and global accept-reject algorithms.

38470 (DOE/ER/40125—15) Theoretical particle physics: Technical progress report, May 1987-May 1988. Hendry, A.W.; Kostelecky, V.A.; Lichtenberg, D.B. (USDOE, Washington, DC; Indiana Univ., Bloomington (USA)). May 1988. Contract AC02-84ER40125. 42p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011809/JAW.

This Technical Progress Report outlines the research of the Task B High Energy Theory Group at Indiana University during 1987-88. We have been active in a variety of

areas{emdash}superstrings, lattice gauge theory, quarkonium and neutrino physics. The following pages provide brief summaries of the progress we were able to make in these areas during the past year. In superstring theory, rules were developed for calculating string amplitudes to the one loop level for a wide variety of topologies; the stability of the string vacuum was investiagted for bosonic strings. We continued our mathematical studies of supergroups. In lattice gauge theory, we have been particularly interested in calculating, from first principles, QCD effects on weak interaction processes (of special interest here is the search for a better understanding of the mysterious {DELTA}I = {1/2} rule). At the same time, we have been trying to develop more efficient algorithms to reduce the amount of computing necessary in lattice calculations. In more phenomenological work, we have been studying various aspects of bound quark-antiquark systems, including a new wave equation which incorporates relativitic kinematics. We have also been trying to find ways of experimentally distinguishing between Dirac and Majorana neutrinos.

38471 **(DOE/ER/40272—51) Calculations in perturbative string field theory.** Thorn, C.B. (Florida Univ., Gainesville (USA). Dept. of Physics). 1987. Contract FG05-86ER40272. 15p. (CONF-8710282—1; UFTP—87-23). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011616/JAW.

From Conference on perspectives in string theory; Copenhagen, Denmark (12 Oct 1987).

The author discusses methods for evaluating the Feynman diagrams of string field theory, with particular emphasis on Witten's version of open string field theory. It is explained in some detail how the rules states by Giddings and Martinec for relating a given diagram to a Polyakov path integral emerge from the Feynman rules.

38472 (INIS-BR—1018, pp 23) **Alternative hamiltonizations for field theories.** Espindola, M.L.; Espindola, O.; Teixeira, N.L. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38473 (INIS-BR—1075, pp 11) **Group of mean field renormalization in the Ashkin Teller model.** Plascak, J.A.; Sa Barreto, F.C. de. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38474 (INIS-BR—1075, pp 16) **Relativistic field theory with dynamic generation of a superconductor gap.** Marino, E.C.; Martins, M.J. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38475 (INIS-BR—1075, pp 16) **Phase transition in Sine-Gordon model.** Simoes, M. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38476 (INIS-BR—1075, pp 17) **SU(5) topological defects at finite temperature.** Marques, G.C.; Guerra Junior, J.M.; Bazeia Filho, D.; Eboli, O.B. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38477 (INIS-BR—1075, pp 18) **Spherical model in random field.** Fontanari, J.F.; Theumann, W.K. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38478 (INIS-BR—1075, pp 24) **λ PHI ⁴d field theory in lattice.** Amaral, M.G. do; Carvalho, C.A.A. de; Pol, M.E.; Shellard, R.C. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38479 (INIS-mf—11219, pp 27-35) **Soft gluon distribution in QCD.** Malaza, E.D. (Institute of Theoretical Physics and Astrophysics, University of Cape Town, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

The distribution of soft gluons resulting from a system of hard partons is studied to all orders of perturbative QCD. With the hard partons produced from a source at mass scale Q^2, perturbative predictions are made in terms of the expansion parameter $\sqrt{\alpha}$/sub S/(Q^2), which is small in the limit Q^2 -> infinity.

38480 (INIS-mf—11219, pp 37-47) **Cavity quantum chromodynamics to order α/sub S/².** Stoddart, A.J.; Viollier, R.D. (Institute of Theoretical Physics and Astrophysics, University of Cape Town, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

Based on perturbative QCD in a cavity, we have calculated, for the two-quark and quark-antiquark systems, all non-diverging graphs to order α/sub S/² which do not involve additional quark-antiquark pairs in the intermediate states. Using the two-body interactions that include the two-gluon exchange and annihilation graphs, we obtain in a satisfactory fit to the low-energy spectrum of hadrons consisting of massless quarks and anti-quarks, in particular the splitting of the masses of the π- and eta-mesons.

38481 (INIS-mf—11219, pp 49-59) **On the deconfinement and chiral symmetry restoration transitions in quantum chromodynamics.** Cleymans, J. (Institute of Theoretical Physics and Astrophysics, University of Cape Town, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

This paper starts with a brief historical introduction after which QCD at finite temperatures will be presented and a simple model for the possible phase structure of QCD will be discussed.

38482 (INIS-mf—11219, pp 73-80) **EMC effect in the small x region.** Nakano, K. (Institute of Theoretical Physics and Astrophysics, University of Cape Town, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

The method of equivalent particle approximation of virtual photons is applied to explain the small x behavior of the EMC effect by incorporating the q-anti-q component of virtual photons. The quark nucleon interaction is estimated by the additive quark model. The nuclear effect is accounted for by considering the probability for the quark propagation through the nuclear medium.

38483 (INIS-mf—11219, pp 81-90) **Electromagnetic neutron structure function.** Nakano, A. (Institute of Theoretical Physics and Astrophysics, University of Cape Town, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

A preliminary result for the electromagnetic neutron structure function via the quark parton model is presented, i.e. without resorting to some functional parametrisation. Only the data on the hydrogen target are used through (μ p), (ν p) and (anti ν p) experiments.

38484 (INIS-mf—11219, pp 91-120) **Nucleon-antinucleon annihilation.** Tegen, R. (Institute of Theoretical Physics and Astrophysics, University of Cape Town, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

Recent relativistic quark-gluon approaches to the understanding of the nucleon-antinucleon annihilation are reviewed. Implications for a better understanding of the short-distance nucleon-nucleon interaction are pointed out. New precise data on the p anti p elastic and charge exchange reaction at the same energies also allow for an independent constraint on both the annihilation range and strength. Both these model parameters are found to be reasonable (quark core size of 0.60 fm and annihilation strength $\sim$ - 2 GeV). We also discuss two unexpected p anti p experimental results (the 'πp puzzle' and the backward rise of the differential cross-section for N anti N->K anti K) which both sensitively depend on the detailed quark dynamics of the annihilation process.

38485 (INIS-mf—11223, pp 221-229) **Nonlocal conformal light-cone expansion in QCD.** Geyer, B.; Robaschik, D.; Horejsi, J. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

A new variant of the nonlocal light-cone expansion in QCD is proposed. The anomalous dimension of the corresponding fermion flavour non-singlet operator is calculated in the one-loop approximation and shown to coincide with the Brodsky-Lepage kernel. The connection of our approach with the standard local conformal light-cone dominated process is considered within the framework of our formalism. The evolution equation obtained earlier by different methods is recovered in a particularly straightforward and compact manner. 11 refs.

38486 (INIS-mf—11223, pp 399-419) **Nonperturbative quantum gauge theories.** Kerler, W. (Marburg Univ. (Germany, F.R.). Fachbereich 13 Physik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

A nonperturbative renormalization procedure is presented. The form to be used for the lattice theory is specified and the aspects of gauge-invariant quantization are discussed. The limit (general nonperturbative renormalization) is defined and the conditions for its existence are given. The various differences to other approaches, in particular to perturbative QFT and to block-spin procedures from statistical mechanics, are discussed. The present knowledge about the parameter singularities in theories of interest is summarized and an outlook on necessary future investigations is given. 26 refs. (M.F.W.).

38487 (INIS-mf—11223, pp 421-425) **Infrared versus gauge properties in quantum field theories.** Calan, C. de. (Ecole Polytechnique, 91 - Palaiseau (France). Centre de Physique Theorique). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The comments on the infrared divergences in QED are presented. 6 refs. (M.F.W.).

38488 (INIS-mf—11223, pp 443-453) **Vacuum problem in the Schwinger model.** Ilieva, N.P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The Schwinger model with quantum motions of bosonic and fermionic vacua is considered. The physical vacuum is defined as a coherent state of the observable fields. Quark-condensates values are found, which depend on the gauge field topological degeneration parameter. 10 refs.

38489 (INIS-mf—11223, pp 455-466) **1+1 dimensional N=1 Wess-Zumino model on the lattice in the local Hamiltonian Monte Carlo method.** Schiller, A. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

Based on a restricted supersymmetry algebra the lattice N=1 Wess-Zumino model in 1+1 dimensions is formulated in such a way that it can be investigated within the local Hamiltonian Monte Carlo method. I find a pattern of supersymmetry breaking which closely follows the expectations of Bartels and Bronzan in an alternative lattice formulation. Supersymmetric solitons with half-integral fermionic charge are observed which are not responsible for the supersymmetry breaking. 13 refs., 3 figs.

38490 (INIS-mf—11223, pp 467-484) **Quarks and gluons at finite temperature and density.** Nakamura, Atsushi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study; Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

I have run computer simulation in SU(2) lattice gauge theory on 8^3 x 2 lattice including dynamical quark loops. No rapid variation is observed in the value of Polyakov line, while the energy densities of quark and gluon show strong indication of a second order phase transition around T $\simeq$ 250 MeV. In order to reduce finite size effects,the results are compared with those of free gas on a lattice of the same size. The quark and gluon energy densities overshoot the free gas values at high temperature. The effects of chemical potential are also studied. The behaviour of the energy densities and the number densities are far from a free gas case. 21 refs., 5 figs.

38491 (INIS-mf—11223, pp 485-494) **Canonical quantization of the periodic Liouville string field theory.** Otto, H.J.; Weigt, G. (Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Physik; Akademie der Wissenschaften der DDR, Berlin-Zeuthen. Inst. fuer Hochenergiephysik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The operator for the periodic Liouville field is given by a canonical transformation on a periodic scalar free field. Necessary quantum corrections of the Liouville operator with respect to its classical expression are fixed by locality and conformal transformation properties. 6 refs.

38492 **(ITEP—50(1987)) Physical vertexes of the bosonic string and the operator product expansion.** Gogolev, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702889/JAW.

The meaning of elimination of spurious states from the full set of operators at the content of the operator product expansion is considered. It is demonstrated explicitely that the unphysical states have no meaning when the scattering amplitude of the theory is interested and that the projective invariance is valid only on physical states. 3 refs.

38493 **(ITF—86-126) Conformally covariant operators and effective action in external gravitational field.** Gusynin, V.P.; Roman'kov, V.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702895/JAW.

The n-dimensional expressions for the second order conformally covariant differentional operators acting on vector and tensor fields and for the fourth order conformally covariant operator acting on scalar fields are obtained. For the fourth order operator one-loop effective action is evaluated in four dimensions. The possibility of effective action evaluation for other conformally covariant operators is discussed. 15 refs.

38494 **(ITF—86-150) On the electron charge fractionization in magnetic field with boundaries present.** Sitenko, Yu.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702896/JAW.

The influence of boundaries on the electron charge fractionization in external static field is investigated. The expression for vacuum charges induced in two-dimensional regions in the form of strips with finite and infinite length are obtained. 18 refs.

38495 **(JINR-E—2-87-16) Finiteness of nonlinear sigma-models on Ricci-Flat manifolds.** Kazakov, D.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702905/JAW.

Submitted to the journal Phys. Lett., B.

It is shown that nonlinear sigma-models can be made finite in 2-2 is an element of dimensions if the background bare metric is chosen to be g/sub ij/(phi)=Σ g/sub ij//sup (k)/ is an element of/ sup k/, where g/sub ij//sup (0)/ is Ricci-flat. This means that despite the appearance of non-zero β-functions in the standard approach, we can construct conformally invariant sigma-models with Ricci-flat metric. Thus the superstring compactification on Calabi-Yau manifolds becomes possible. 10 refs.

38496 **(JINR-E—2-87-588) Minimal quantization of two-dimensional models with chiral anomalies.** Ilieva, N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702910/JAW.

Submitted to the journal Intern. J. Modern Phys. .

Two-dimensional gauge models with chiral anomalies - "left-handed" QED and the chiral Schwinger model, are quantized consistently in the frames of the minimal quantization method. The choice of the cone time as a physical time for system of quantization is motivated. The well-known mass spectrum is found but with a fixed value of the regularization parameter a=2. Such a unique solution is obtained due to the strong requirement of consistency of the minimal quantization that reflects in the physically motivated choice of the time axis. 13 refs.; 2 figs.

38497 **(JINR-R—2-87-386) Euclidean measure for the electromagnetic field.** Loeffelholz, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702926/JAW.

A rigorous Euclidean approach to the quantization of the electromagnetic field F/sub ij/(x), x=(t, x) is not an element of R^4 is given, which we consider as a family of coordinates on some probability space (Ω, Σ, μ). Our main result is the construction of an isomorphism $\Sigma I \sim \sigma(2UB^0)$, where the ideal I corresponds to Faraday's law and 2, B^0 are σ-subalgebras. In particular, the restriction μB-vector^0 appears to be part space measure for a Markov process t is not an element of R -> B/sub ij/ (t,x). Using a Feynman-Kac formula the photon propagator is derived. 16 refs.; 2 figs.

38498 **(LBL—24883) Beyond the supersymmetric standard model.** Hall, L.J. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 26p. (CONF-8707163—1; UCB-PTH—88/3; CONF-8707163—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010775/JAW.

From TASI School; Santa Fe, NM, USA (27 Jul 1987).

The possibility of baryon number violation at the weak scale and an alternative primordial nucleosynthesis scheme arising from the decay of gravitations are discussed. The minimal low energy supergravity model is defined and a few of its features are described. Renormalization group scaling and flavor physics are mentioned.

38499 **(RAL—87-115) Proceedings of the school for young high energy physicists, Rutherford Appleton Laboratory, September 8-20 1986.** Dainton, J.B. (ed.). (Rutherford Appleton Lab., Chilton (UK)). [1987]. 231p. (CONF-8609425—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753518/JAW.

From School for young high energy physicists; Chilton, UK (8 Sep 1986).

38500 (RAL—87-115, pp 1-39) **Introduction to quantum electrodynamics.** Webber, B.R. (Cambridge Univ. (UK)). [1987]. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753518/JAW. (CONF-8609425—).

From School for young high energy physicists; Chilton, UK (8 Sep 1986).

The aim of the lectures was to introduce techniques for performing simple calculations in quantum electrodynamics. Topics discussed in the lecture course included: the Klein-Gordon equation, Dirac equation and scattering amplitudes. (U.K.).

38501 (RAL—87-115, pp 77-156) **Quantum field theory, symmetries and gauge theories.** Aitchison, I.J.R. (Oxford Univ. (UK)). [1987]. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753518/JAW. (CONF-8609425—).

From School for young high energy physicists; Chilton, UK (8 Sep 1986).

The lecture course was divided into eight topics, and included: the quantum field, the Lagrange-Hamilton formulation relativity, massive particles and fermions, interactions in quantum field theory, symmetries in quantum field theory, and the GSW electroweak theory. (U.K.).

38502 (RAL—87-115, pp 41-76) **Introduction to quantum chromodynamics.** Irving, A.C. (Liverpool Univ. (UK)). [1987]. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753518/JAW. (CONF-8609425—).

From School for young high energy physicists; Chilton, UK (8 Sep 1986).

The lecture course was divided into six topics which included: renormalisation of scalar quantum field theory, QCD - an asymptotically free theories deep inelastic scattering at 0th order in QCD: the parton model, QCD corrections to scaling, JET production and non-perturbative QCD. (U.K.).

38503 **(TRI-PP—88-9) An overview of lattice QCD.** Woloshyn, R.M. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1988. 16p. (CONF-880331—3). NTIS (US Sales Only), PC A03/MF A01;1; GPO Dep. Order Number DE88010867/JAW.

From 3. Lake Louise Winter Institute on quantum chromodynamics: theory and experiment; Lake Louise, Canada (6 Mar 1988).

The basic concepts of the Lagrangian formulation of lattice field theory are discussed. The Wilson and staggered schemes for dealing with fermions on the lattice are described. Some recent results for hadron masses and vector and axial vector current matrix elements in lattice QCD are reviewed. 118 refs., 16 figs.

38504 **Finite-size effect in the Schwinger particle-production mechanism.** Wang, R.; Wong, C. (Oak Ridge National Laboratory and Joint Institute for Heavy-Ion Research, Oak Ridge, Tennessee 37831). *Physical Review [Section] D: Particles and Fields;* **38**: No. 1, 348-359(1 Jul 1988).

The Schwinger mechanism of particle production in a strong and uniform electric field for an infinite system is generalized to the case where the strong field is confined between two condenser plates separated by a finite distance. The production rates, for both bosons and fermions, are obtained by solving the Klein-Gordon equation and the Dirac equation in a linear vector potential. They are expressed in terms of parabolic cylinder functions for bosons, and in terms of the confluent hypergeometric functions for fermions. Numerical evaluation of these results shows large deviations of the production rate from what one deduces with the Schwinger formula, indicating a large finite-size effect in particle production.

38505 **Resource Letter: GI-1 Gauge invariance.** Cheng, T.P.; Li, L. (Department of Physics, University of Missouri, St. Louis, Missouri 63121 and School of Natural Sciences, Institute for Advanced Study, Princeton, New Jersey 08540). *American Journal of Physics;* **56**: No. 7, 586-600(Jul 1988).

Gauge symmetry has become one of the most basic concepts in the theoretical framework for understanding fundamental interactions: The quantum field theories of the strong, weak, and electromagnetic interactions are all gauge invariant; general relativity can also be viewed as a classical gauge theory. This Resource Letter is intended for nonspecialists who wish to study gauge theories and their applications to elementary particle physics. About half of our discussion is devoted to the general properties of gauge-invariant quantum field theories and half to their applications, from QED, QCD, and the Weinberg—Salam model to grand unification. The letter E after an item indicates elementary level or material of general interest to persons becoming informed in the field. The letter I, for intermediate level, indicates material of somewhat more specialized nature; and the letter A indicates rather specialized or advanced material. An asterisk (*) indicates those articles to be included in an accompanying Reprint Book.

38506 **Comment on "Spontaneous generation of string tension and quark potential".** Braaten, E.; Tse, S.; Pisarski, R.D. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201 and Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review Letters;* **60**: No. 26, 2806-2806(27 Jun 1988).

A Comment on the Letter by H. Kleinert, Phys. Rev. Lett. 58, 1915 (1987).

38507 **BRST primer.** Nemeschansky, D.; Preitschopf, C.; Weinstein, M. (Department of Physics, University of Southern California, Los Angeles, California 90089). *Annals of Physics (New York);* **183**: No. 2, 226-268(1 May 1988).

We develop a Hamiltonian formulation of the BRST method for quantizing constrained systems. The rigid rotor is studied in detail and the similarity of this simple quantum system to a guage theory is explicitly demonstrated. The system is quantized as a gauge theory and then the similarity between BRST and the Gupta—Bleuler approach is displayed. We also apply our formalism to true gauge theories. Both Abelian and non-Abelian gauge theories are studied in detail. Finally, the Hamiltonian treatment of the relativistic and the spinning relativistic particle is presented. copyright 1988 Academic Press, Inc.

38508 **Ambiguity in fermionic string perturbation theory.** Atick, J.J.; Rabin, J.M.; Sen, A. (Institute for Advanced Study, Princeton, NJ (USA); California Univ., San Diego, La Jolla (USA). Dept. of Mathematics; Stanford Linear Accelerator Center, CA (USA)). *Nuclear Physics [Section] B;* **299**: No. 2, 279-294(4 Apr 1988). Contract AC02-76ER02220;AC02-82ER40073;AC03-76SF00515.

Recent investigation by Verlinde and Verlinde has shown that the fermionic string loop amplitudes change by a total derivative term in the moduli space under a change of basis of the supermoduli. This ambiguity is addressed in the context of the heterotic string theory, and shown to be a consequence of an inherent ambiguity in defining integration over the variables of a Grassmann algebra - in this case the Grassmann-valued coordinates of the supermoduli space. A resolution of this ambiguity in genus-two within this formalism is also presented.

38509 **Renormalisation of gauge theories using effective Lagrangians, I.** Warr, B.J. (California Institute of Technology, Pasadena, California 91125). *Annals of Physics (New York);* **183**: No. 1, 1-58(Apr 1988).

The renormalisation of field theories is unterstandable in an elegant way in terms of the flow of effective LAgrangians. At distances much larger than some physical cutoff, the physics is described by a small number of parameters, which can be identified purely by dimensional analysis. For scalar theories a rigorous yet simple proof of renormalisability based on this concept was given by Polchinski. For gauge theories there is the extra issue of unitarity of the renormalized S-matrix, which can only be guaranteed by proving renormalised Ward identities, and in this paper we carry this out for the case of non-chiral matter couplings. The second paper in this series extends to chiral theories and to N = 1 supersymmetric Yang-Mills. copyright 1988 Academic Press, Inc.

38510 **Renormalisation of gauge theories using effective Lagrangians, II.** Warr, B.J. (California Institute of Technology, Pasadena, California 91125). *Annals of Physics (New York);* **183**: No. 1, 59-79(Apr 1988).

The method of effective Lagrangian flow provides the most physically illuminating discussion of renormalisation theory. The extra complication of the unitarity question in gauge theories was solved in the first paper (for the non-chiral case) and in this paper we extend the results to chiral gauge theories and rigid N = 1 super Yang—Mills. We prove that one-loop anomaly cancellation is a sufficient condition for unitarity, and we also prove the Adler—Bardeen theorem for the divergence of a non-gauged axial current. Finally, we show that the gravitational anomalies of a gauged current are removed completely when canceled at the one-loop level. copyright 1988 Academic Press, Inc.

38511 **Dysfunctional methods and the effective potential.** Dannenberg, A. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Physics). *Physics Letters [Section] B;* **202**: No. 1, 110-116(25 Feb 1988). Contract AC03-76SF00098.

The effective potential is a useful and much-studied object. It is known to be both real and convex, but a perturbative calculation often gives a complex and nonconvex result. In this letter we address the apparent conflict between perturbation theory and the convexity of the effective potential.

38512 **Analytic and numerical results on the chiral transition in SU(2) lattice gauge-Higgs theory with fermions.** Lee, I.H ; Shrock, R.E. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.; State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics). *Physics Letters [Section] B;* **201**: No. 4, 497-502(18 Feb 1988). Contract AC02-76CH00016.

We present an analytic study of the (zero-temperature) chiral symmetry-breaking phase transition in SU(2) lattice gauge-Higgs theory with fermions, relevant to the SU(2) sector of the standard electroweak theory. The transition is found to be second-order and the critical gauge-Higgs coupling is calculated in the limit of strong gauge coupling. New Monte Carlo measurements for quenched I=1/2 fermions are presented and found to be in excellent agree-

ment with the analytic results, which are not limited to the quenched approximation.

38513 **Example and dimensional regularization with antisymmetric tensors.** Bos, M. (Center for Theoretical Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Annals of Physics (New York);* **181**: No. 2, 177-197(1 Feb 1988).

Dimensional regularization with antisymmetric tensors is discussed on the basis of a specific example, the two-dimensional WZW model. A manifestly self-consistent definition of ϵ/sup μ// sup ν/ is used, violating the full Lorentz invariance of the dimensionally continued space-time. The ensuing apparent pathology in the renormalization procedure is resolved by a careful study of the renormalization group. The argument is checked and illustrated by explicit calculations up to three loops. copyright 1988 Academic Press, Inc.

65 PHYSICS II

38514 **(UCRL—53689-87) Institutional research and development, FY 1987.** Struble, G.L.; Lawler, G.M.; Crawford, R.B.; Kirvel, R.D.; Peck, T.M.; Prono, J.K.; Strack, B.S. (eds.). (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 209p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88010415/JAW.

The Institutional Research and Development program at Lawrence Livermore National Laboratory fosters exploratory work to advance science and technology, disciplinary research to develop innovative solutions to problems in various scientific fields, and long-term interdisciplinary research in support of defense and energy missions. This annual report describes research funded under this program for FY87. (DWL)

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 38594, 38992

38515 **(BNL—41123) Transverse energy distributions in ^{16}O-nucleus collisions.** Corriveau, F. (Brookhaven National Lab., Upton, NY (USA); McGill Univ., Montreal, Quebec (Canada). Dept. of Physics). 27 Nov 1987. Contract AC02-76CH00016. 7p. (CONF-8708166—6). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009891/JAW.

From 6. international conference on ultra-relativistic nucleus-nucleus collisions; Nordkirchen, F.R. Germany (24 Aug 1987).

38516 **(BNL—41308) Transverse energy flow in 10 GeV/nucleon ^{28}Si nucleus collisions.** Fatyga, M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-880399—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012143/JAW.

From 23. Rencontre de Moriond: current issues in hadron physics; Les Arcs, France (13 Mar 1988).

Transverse energy distributions have been measured for collisions of 10 GeV/nucleon Si with targets of Al, Cu, and Pb using a combination of a NaI wall and a uranium/copper calorimeter. Very large stopping is observed, with continuous evolution of angular distributions of reaction products for the increasing mass of the target.

38517 **(CONF-871101—83) Preparation and benchmarking of ANSL-V cross sections for advanced neutron source reactor studies.** Arwood, J.W.; Ford, W.E. III; Greene, N.M.; Primm, R.T. III; Waddell, M.W.; Webster, C.C.; Westfall, R.M.; Wright, R.Q. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. (CONF-871101—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008685/JAW.

From California State Air Resources Board; Los Angeles, CA, USA (15 Nov 1987).

Validity of selected data from the fine-group neutron library was satisfactorily tested in performance parameter calculations for the BAPL-1, TRX-1, and ZEEP-1 thermal lattice benchmarks. BAPL-2 is an H_2O moderated, uranium oxide lattice; TRX-1 is an H_2O moderated, 1.31 weight percent enriched uranium metal lattice; ZEEP-1 is a D_2O-moderated, natural uranium lattice. 26 refs., 1 tab.

38518 **(DOE/ER/40269—2) [Pion-nucleus interactions and nucleon transfer reactions primarily at LAMPF, TRIUMF, and IUCF]: Technical progress report, [October 1, 1986-October 1, 1987].** Kraushaar, J.J. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). 1 Oct 1987. Contract FG02-86ER40269. 131p. (NPL—1028). NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88008048/JAW.

This report summarizes work carried out between October 1, 1986 and October 1, 1987 in the Nuclear Physics Laboratory of the Department of Physics at the University of Colorado, Boulder. Other efforts in the laboratory, such as development of an R.F. cavity for an advanced hadron facility accelerator, beam pickoff devices, a buncher for the LAMPF proton beam, and the US-Brazil Cooperative Science Program are described.

38519 (INIS-mf—11223, pp 313-329) **Charged particle multiplicities in π^-, K^-, p-bar interactions with nuclei and high p perpendicular to π^- A interactions at 40 GeVc.** Bohm, G.; Friebel, W.; Gensch, U. (Akademie der Wissenschaften der DDR, Berlin-Zeuthen. Inst. fuer Hochenergiephysik). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

Results from two experiments performed with the RISK streamer chamber spectrometer at 40 GeVc of incident momentum are presented. In the first one interactions of π^-, K^-, and p-bar on Li,C,S,Cu,Cs1 and Pb were studied, in the second one the interactions of π^- on C,Cu and Pb were selected with single particle high p perpendicular to trigger. Charged particles and protons multiplicities as well as correlations between them were investigated. The use of high p perpendicular to trigger led to the increase of all observed multiplicities. 9 refs., 9 figs., 2 tabs.

38520 **(SLAC—316) Workshop on electronuclear physics with internal targets: Proceedings.** Arnold, R.G.; Minehart, R.C. (eds.). (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC03-76SF00515. 227p. (CONF-870165—). NTIS, PC A11;3. Order Number DE88010766/JAW.

From Workshop on electronuclear physics with internal targets; Stanford, CA, USA (5 Jan 1987).

The Workshop on Electronuclear Physics with Internal Targets was held at SLAC on January 5-8, 1987. The idea for this workshop grew out of interest among physicists at SLAC and MIT/Bates who have been exploring the possibilities for internal targets in the PEP ring at SLAC and in a proposed stretcher ring at MIT/Bates. The aim of the workshop was to bring together physicists from these groups and from other laboratories and universities to discuss the new physics that could be made accessible with internal targets, and to share information on recent developments in internal target technology, on the impact of internal targets on ring operation, and on the detector requirements. The workshop was sponsored by NPAS, the program of Nuclear Physics at SLAC, and it was attended by more than 100 physicists from the US, Canada, Europe, and Japan. The workshop sessions began with two days of invited talks followed by two days of shorter presentations organized by the chairmen of four Working Groups. Written versions of all the plenary talks and all but four of the Working Group talks are presented here.

38521 **Recent References: September through December 1987.** Ramavataram, S. (Brookhaven National Laboratory, Upton, New York 11973). *Nuclear Data Sheets;* **53**: No. 3, 407-490(Mar 1988).

A bibliography and reaction index are presented for all literature received by the National Nuclear Data Center or assigned keywords between September and December 1987. (AIP)

38522 **Thick-target bombardments with high energy charged particles: Experimental improvements and spatial distribution of low-energy secondary neutrons.** Englert, P.; Reedy, R.C.; Arnold, J.R. (San Jose State Univ., CA (USA). Dept. of Chemistry; Los Alamos National Lab. (LANL), NM (USA). Earth and Space Sciences Div.; California Univ., San Diego, La Jolla (USA). Dept. of Chemistry). *Nuclear Instruments and Methods in Physics Research;* 262: No. 2/3, 496-502(15 Dec 1987).

A thick target with dimensions of 100x100x200 cm and a mass of about 16 000 kg was constructed for the simulation of effects of the galactic cosmic radiation (GCR) with matter. After irradiations of this target with 2.1-GeV protons and 800-MeVnucleon alpha particles, the spatial distribution of low-energy secondary neutrons was determined by neutroncapture reaction products. Due to the large dimensions of the bombarded target and the water-free material used, conditions close to those expected in anhydrous planetary surfaces were successfully simulated, with the exception of the 2π incidence of the GCR. Secondary low-energy neutron luxes developed broad maxima at depths of 100 to 200 gcm^{2} for the proton irradiation and at depths of 70 to 150 gcm^{2} for the alpha particle run. These observations are in agreement with predictions and other observations for the proton experiment. The alpha-particle irradiation, however, demonstrates the role that these particles, which only comprise proportional to 10% of the GCR particle flux, play on the development of the subsurface low-energy neutron fluxes in extraterrestrial objects. Gomparisons with similar results from other thick target experiments demonstrate the advantages of the thick target arrangement used.

38523 **Integral test of several fission cross-sections in the neutron spectrum produced by 7-MeV deuterons incident on a thick Be-metal target.** Watanabe, Y.; Meadows, J.W.; Smith, D.L. (Argonne National Lab., IL (USA)). *Annals of Nuclear Energy;* 14: No. 10, 563-569(1987). Contract W-31-109-ENG-38.

Integral neutron-fission cross-section ratios have been measured for ^{232}Th^{236}U, ^{237}Np^{235}U, ^{238}U^{235}U, ^{237}Np^{238}U, ^{232}Th^{237}Np, ^{236}U^{235}U, ^{239}Pu^{235}U, ^{233}U^{235}U, ^{234}U^{235}U, ^{234}U^{236}U and ^{236}U^{238}U in the continuum neutron spectrum produced by bombardment of a thick Be-metal target with 7-MeV deuterons. A consistent set of fission cross-sections relative to ^{235}U was obtained and compared with calculated values based on the representation of the neutron spectrum derived from time-of-flight measurements and the ENDFB-V and JENDL-2 evaluations of the differential cross-sections. It was found that the results are relatively insensitive to small changes in the representation of the neutron spectrum. The calculated and experimental values for most of the isotopes are consistent within the experimental error, but for ^{234}U and ^{236}U the calculated cross-sections are high by 6-7% which suggests that a re-normalization of these cross-sections may be needed in the 1-6 MeV region.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 37033, 37564, 38534, 38596

38524 **(AD-A—190306/1/XAB) SDIO/IST ultrashort-wavelength laser. Moessbauer effect in gamma-ray lasers. Interim report for period ending 28 February 1987.** Hoy, G.R.; Taylor, R.D. (Old Dominion Univ., Norfolk, VA (USA)). Mar 1987. 26p. NTIS, PC A03/MF A01.

In order to gain some perspective on the relationship of the Moessbauer effect to the possible development of gamma-ray lasers, it is useful to review the Moessbauer-effect literature. These results show that: 1) Rayleigh and nuclear resonant diffraction by scattering is small, 2) nuclear anomalous dispersion occurs, 3) interference can occur between nuclear hyperfine components in nuclear resonant diffraction, 4) in nuclear-resonant Bragg scattering, processes having different final nuclear spin projections are incoherent, and 6) there can be anomalously deep penetration and high reflectivity using single crystals as a result of the suppression of inelastic channels.

38525 **(DOE/ER/10493—16) Atomic mass measurements and nuclear spectroscopy at TRISTAN and nuclidic mass measurements at LAMPF: Progress report for the period February 1, 1985-August 31, 1987.** Brenner, D.S. (Clark Univ., Worcester, MA (USA)). Sep 1987. Contract AC02-79ER10493. 22p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008001/JAW.

The Clark University research program is concerned with experimental determination of the nuclear structure of isotopes far from the line of β stability and their masses. This work is accomplished, primarily, by use of the TRISTAN on-line mass separator located at the High Flux Beam Reactor, Brookhaven National Laboratory, where investigations of short-lived fission products have been actively pursued since 1980. In 1985 mass measurements of light isotopes produced by fragmentation reactions on heavy targets were initiated using the TOFI (Time-of-flight Isochronous) Spectrometer at the LAMPF accelerator, Los Alamos National Laboratory. Together, the two facilities are capable of providing complementary information, potentially of great value in understanding the sum total effect of all nuclear interactions in a given nucleus, which gives rise to the property known as the mass. The thrust of the spectroscopic studies at TRISTAN has been to develop a database for neutron-rich, far-from-stability nuclides in order to provide a new testing ground for nuclear models. In particular, we have been active in pursuing microscopic and phenomenological understanding of nuclear structure in regions of shape transition near shell and subshell closures. Recent efforts have been concentrated on exploiting some very new ideas based on the pervasive influence of the proton-neutron interaction that offer the possibility of achieving a unified interpretation of nuclear structure and its evolution, of the interrelationships of different nuclear shapes and modes of excitation, and of the nuclear mass.

38526 **(LA-UR—88-1696) Status of fission yield data.** England, T.R.; Blachot, J. (Los Alamos National Lab., NM (USA); CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880546—4). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010918/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

In this paper we summarize the current status of the recent US evaluation for 34 fissioning nuclides at one or more neutron incident energies and for spontaneous fission. Currently there are 50 yields sets, and for each we have independent and cumulative yields and uncertainties for approximately 1100 fission products. When finalized the recommended data will become part of Version VI of the US ENDF/B. Other major evaluations in progress that are included in a recently formed IAEA Coordinated Research Program are also summarized. In a second part we review two empirical models in use to estimate independent yields. Comparison of model estimates with measured data is presented, including a comparison with some recent data obtained from Lohengrin (Cf-249 T). 18 refs., 13 figs., 3 tabs.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

38527 **(BONN-IR—87-47) Photofission of polarized deuterons. Measurements of angular distributions at E/sub γ/ = 450 and 650 MeV.** Sundermann, D. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Dec 1987. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753536/JAW.

At the Bonn 2.5 GeV electron synchrotron we have measured the vector target asymmetry of the reaction γ+d/sub arrow up/ -> p+n with a polarized deuterium target. We have taken data at photon energies of 450 MeV and 650 MeV and at proton-cm-angles between 25° and 155° by using a bremsstrahlung photon beam. With the new target material deuterated ammonia we yielded a maximum vector polarization of 44% for the deuterons at 0.2 K. Proton and neutron were detected in coincidence. The total photon energy acceptance was divided into bins down to 30 MeV by using Monte Carlo techniques. We determined the energy dependence of the target asymmetry for photon energies between 400 and 700

MeV for every measured proton angle. A fit to the data was performed in order to investigate the maximum total angular momentum which occurs. For one kinematical setting also the tensor asymmetry Z was measured for the first time. Our results are compared with theoretical analyses, best qualitative agreement for T is obtained with a relativistic Bonn analysis. (orig.HSI).

38528 (CEA-N—2539) Contributions to the study of the reaction pd→tπ⁺. Kerboul, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie; Strasbourg-1 Univ., 67 (France)). Jun 1987. 174p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752565/JAW.

We have measured the excitation function of the analysing power T/sub 20/ and of the cross section, at 0 deg and 180 deg, from threshold to 2.2 GeV for the antidp->/sup 3/Heπ/sup 0/ reaction. We have also measured the angular distributions of the analysing power Ay for the antipd->tπ/sup +/ reaction, at 1.2, 1.3 and 1.45 GeV. Having measured T/sub 20/ and the cross section at 0 deg, we have extracted the experimental values of the two independent amplitudes for (polarized)d.p->/sup 3/Heπ/sup 0/ in colinear kinematics. At threshold, the value of T/sub 20/ is near the absolute minimum, showing that the pion at rest is absorbed on an S=1 pair of nucleons in /sup 3/He. We have analysed our data with microscopic calculations in terms of two-body and three-body mechanisms. At 0 deg, only two-body mechanisms are important. At 180 deg, even in the resonance (3.3) excitation region, three-body mechanisms are necessary and become dominant around T/sub d/ = 2 GeV. Nevertheless, the analysing power is not reproduced by calculations including all these mechanisms. It seems that the spin-flip amplitude is never well described.

38529 (CONF-880386—7) Physics in the GeV region with polarized targets in electron storage rings. Holt, R.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011966/JAW.

From International conference on spin-observables in nuclear physics; Telluride, CO, USA (14 Mar 1988).

There is evidence from the D(γ,p)n reaction that the meson-exchange model is failing in the GeV region. Surprisingly, it appears that the new (Dγ,p)n data favor the energy dependence of the nuclear chromodynamics model rather that of the meson-exchange model. Application of the polarization method to electron scattering studies is in its infancy, and it is potentially a very powerful technique. The internal target method coupled with laser-driven polarized targets should represent an important tool for nuclear physics.

38530 (CONF-880560—2) Two-body photodisintegration of the deuteron above 1 GeV. Holt, R.J.; Freedman, S.J.; Geesaman, D.F.; Gilman, R.; Green, M.C.; Jackson, H.E.; Kowalczyk, R.; Marchand, C.; Napolitano, J.; Nelson, J. (Argonne National Lab., IL (USA); California Inst. of Tech., Pasadena (USA); Northwestern Univ., Evanston, IL (USA); American Univ., Washington, DC; Massachusetts Inst. of Tech., Cambridge (USA); Stanford Univ., CA (USA)). 1988. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012037/JAW.

From Topical conference on nuclear quantum chromodynamics; Argonne, IL, USA (19 May 1988).

One of the central issues in nuclear physics is the identification of clear signatures for quarks in nuclei. A guiding principle in this search is to perform experiments with high energy electromagnetic probes of the simplest nucleus, the deuteron, a system which is particularly amenable to theoretical interpretation. It has long been known that the quark counting rules seem to apply for electron elastic scattering from the pion and nucleon. However, the rapid decline in the cross section for electron scattering from the deuteron, a six-quark system, renders an experiment at high momentum transfer unfeasible. Clearly, the dimensional-scaling region is not reached for electron-deuteron elastic scattering as indicated. This led Brodsky and Chertok to analyze these data in terms of the reduced nuclear amplitudes and produce, in effect, scaling at a lower momentum transfer. Presently, this is the only known case where the reduced nuclear amplitude analysis seems to apply. In the present work we abandon elastic electron scattering in favor of an exclusive photoreaction with the deuteron. The simplest process involving a nucleus is the γd → pn reaction. Here, n = 13 and an s^{-11} dependence is expected where the quark counting rules are valid. Naively, one would expect that the energy region where the quark counting rules are valid to be most naturally described in terms of a quark or parton basis rather than a nucleon basis, and thereby provide a signature quark effects in nuclei. Hitherto no s^{-11} dependence has been observed for the data below 1 GeV. As a test of the energy-dependence for the γd → pn reaction, we have performed the first measurements for this process above 1 GeV.

38531 (CONF-8805142—2) Measurement of two-body deuteron photodisintegration at high photon energies and theta/sub CM/ = 90°. Napolitano, J.; Freedman, S.J.; Geesaman, D.F.; Gilman, R.; Green, M.C.; Holt, R.J.; Jackson, H.E.; Kowalczyk, R.; Marchand, C.; Nelson, J. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA); American Univ., Washington, DC; Massachusetts Inst. of Tech., Cambridge (USA); Stanford Univ., CA (USA); Virginia Univ., Charlottesville (USA)). 1988. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011996/JAW.

From 3. conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The authors report preliminary results from a measurement of the process $^2H(\gamma,p)n$ at theta/sub CM/ = 90° and for photon energies between 0.8 and 1.6 GeV. The results are compared to a conventional calculation based on meson-exchange and to models based on sub-nucleonic degrees of freedom. We find strong disagreement with the meson-exchange calculation, and best agreement with simple constituent counting at the highest energies.

38532 (CONF-8805142—4) Measurement of the deep-inelastic spin-dependent structure functions of the proton and neutron at HERA. Beck, D.H.; Filippone, B.W.; Jourdan, J.; McKeown, R.D.; Milner, R.G.; Woodward, C.E.; Freedman, S.J.; Geesaman, D.F.; Holt, R.J.; Jackson, H.E. (California Inst. of Tech., Pasadena (USA). W.K. Kellogg Radiation Lab.; Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012052/JAW.

From 3. conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

It is possible to measure the deep-inelastic spin-dependent structure functions g_1/sup p/(x) and g_1/sup n/(x) for the proton and neutron using internal polarized hydrogen, deuterium, and ^3He targets of polarization 50% and thickness 10^{14} to 10^{15} cm^{-2} and the 60 mA longitudinally polarized 30 GeV electron beam in the HERA electron storage ring. The measurement of the deep-inelastic spin-structure of both isospin states of the nucleon at the same kinematics and using the same apparatus allows the Bjorken sum rule to be experimentally checked. In addition, it uniquely constrains the spin distribution of the u and d quarks as a function of x in any model of the nucleon. Possible target and detector configurations are described and an estimate of the accuracy of such a measurement is presented.

38533 (UCRL—97405) Triton memory time in solid DT and its nuclear polarization. Souers, P. C.; Fearon, E. M.; Mapoles, E. R.; Sater, J. D.; Collins, G. W.; Gaines, J. R.; Sherman, R. H.; Bartlit, J. R. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 35p. (CONF-880505—19). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011337/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The expected value of nuclear spin polarization to inertial confinement fusion is recapitulated. A comparison of brute force versus dynamic nuclear polarization, as applied to solid deuterium-tritium, is given, and the need for a long triton polarization memory time (longitudinal nuclear relaxation time) is shown. The time constant for 25 mol%T_2-50 DT-25 D_2 is a short 0.3 s at 5{degree}K and waiting lowers it to 0.1 s. Use of 90 to 96 mol% molecular DT raises the time constant to 0.9 s and addition of

about 20 mol% nH_3 increases it to 5 to 7 s. The theory shows that the species shortening the triton memory time is the J = 1 T_2, which can be reduced in our samples only by self-catalysis. The heating in order to mix in nH_3 increases the percent of J = 1 T_2 and mixing may not be perfect. The experiments have increased the triton memory time twenty-fold and shown that removal of the J = 1 T_2 is the key to improved results.

38534 **(UCRL—98648) Problems and progress in tritium beta decay.** Balke, B.; Fackler, O.; Mugge, M.; White, R. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 7p. (CONF-880173—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010616/JAW.

From 22. Moriond workshop on neutrinos and exotic phenomena in particle physics and astrophysics; Les Arcs, France (23 Jan 1988).

It has been nearly eight years since the group led by Lubimov first saw evidence for a finite neutrino mass in the tritium beta decay spectrum. Their measurement provided a great stimulus to the field; the number of experiments currently underway reflects the significance of their claim. The fact that further data are only now beginning to appear reflects the difficulty of this measurement. As an introduction to related papers in these proceedings, we briefly consider the key elements involved in neutrino-mass measurements using tritium beta decay and list the experiments currently underway in the field. 5 refs., 1 tab.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

38535 **(CENBG—8717) Separation and spectroscopic study of exotic nuclei at GANIL.** Jean, D. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Jul 1987. 222p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753941/JAW.

A new isotopic separation method is presented. It allows the studies of radioactive atomic nuclei produced in high energy heavy ions collisions. Two experiments were performed at the GANIL facilities (Grand Accelerateur National d'Ions Lourds, Caen). They are analysed on the fields of the experimental resolution and of the spectroscopic results. Measurements of beta decay half lives and gamma spectra are brought for sixteen neutron rich nuclei at the frontier of the experimental knowledge.

38536 **(CONF-880546—15) Neutron standard data.** Peelle, R.; Conde, H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011398/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The neutron standards are reviewed with emphasis on the evaluation for ENDFB-VI. Also discussed are the neutron spectrum of ^{252}Cf spontaneous fission, activation cross sections for neutron flux measurement, and standards for neutron energies greater than 20 MeV. Recommendations are made for future work. 21 refs., 6 figs., 3 tabs.

38537 **(CONF-880546—18) Interplay of direct and compound-nucleus mechanisms in neutron capture by light nuclides.** Raman, S.; Kahane, S.; Lynn, J.E. (Oak Ridge National Lab., TN (USA); Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; UKAEA Atomic Energy Research Establishment, Harwell). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011828/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The authors discuss the direct-capture theory pertaining to primary electric-dipole (E1) transitions following slow-neutron capture. For approximately 20 light nuclides that we have studied, estimates of direct-capture cross sections using optical-model potentials with physically realistic parameters are in reasonable agreement with the data. Minor disagreements that exist are consistent with extrapolations to light nuclides of generally accepted formulations of compound-nucleus capture. In dealing with nuclei soft to vibrations, we have considered the possible effects of coupling of the collective motion with the optical potential in the framework of R-matrix theory. In such cases, we find that the inclusion of inelastic channels results in systematic changes in the calculated cross sections.

38538 **(CRN-PN—87-19) Incomplete fusion and preequilibrium emission in the reactions $^{40}Ar + {}^{45}Sc$, $^{40}Ar + {}^{24}Mg$, $^{40}Ar + {}^{13}C$ at 27.5 MeV by nucleon.** Gonin, M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Nov 1987. 79p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753945/JAW.

The evaporation residues were detected by means of a heavy ion time of flight system. As an attempt to examine in detail incomplete fusion for medium and light mass systems we have studied the reactions with experimental conditions allowing a complete separation and identification of the final products. We have analysed the velocity of the evaporation residues. The preequilibrium particles appear to be governed by two different regimes. The results show clearly that various compound nuclei are formed in the incomplete fusion process. The $^{40}Ar + {}^{13}C$ reaction appears to be a special case. In the $^{40}Ar + {}^{24}Mg$ reaction, the study of preequilibrium particles in coincidence with evaporation residues confirms the results suggested for the heavy fragments.

38539 **(CRN-PN—87-20) Trends in central collisions of light and medium mass heavy ions.** Coffin, J.P. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1987. 16p. (CONF-8710326—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753481/JAW.

From Institut National de Physique Nucleaire et de Physique des Particules (IN2P3 - France) and by the Institut of Physical and Chemical Research; Riken, Japan (12 Oct 1987).

The correlated phenomena of preequilibrium emission and incomplete fusion in heavy ion collisions at low impact parameters are discussed for the $^{40}Ar + {}^{13}C$, ^{24}Mg and ^{45}Sc reactions, performed at E/sub 40Ar/=27.5 MeVnucleon. Inclusive and exclusive data relative to heavy residues and light particles are presented. The characteristics of preequilibrium emission and incomplete fusion are examined, and observations at variance with earlier conclusions are considered. Transient modes from evaporation towards multifragmentation or incomplete fusion versus massive transfer of nucleons are discussed.

38540 (INIS-BR—1018, pp 17) **Ternary fission of aluminium, titanium, cobalt and zirconium induced by photons from 0.8 to 1.8 GeV.** Sousa, E.V. de; Milomen, W.C.C.; Lima, D.A. de; Tavares, O.A.P.; Husmann, D. (Paraiba Univ., Campina Grande (Brazil). Dept. de Fisica; Mato Grosso Univ., Cuiaba (Brazil). Dept. de Fisica; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Bonn Univ. (Germany, F.R.)). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38541 (INIS-mf—11223, pp 271-288) **Results on hadron production in 200 GeV μ-Cu and μ-C deep inelastic interactions from the EMC.** Nassalski, J. (Institute of Nuclear Research, Warsaw (Poland)). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The nuclear structure function F_2 effects and the effects of the jet absorption in the nuclear matter are searched for in the z-distributions of charged hadrons. The nuclear absorption effects in Cu relative to C are seen only for the virtual photon energies below 70 GeV. The results indicate that at higher energies the parton fragmentation distances are greater than the nuclear radius

and that the parton absorption cross section is less than 10 mb. 8 refs., 6 figs.

38542 (JINR-E—1-87-246) Observation of the dominance of the target Δ excitation and their collective nature in the (^{3}He,t) charge-exchange at high energies. Ableev, V.G.; Eliseev, S.M.; Inosemtsev, V.I. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702903/JAW.

Submitted to the 11. Intern. Conference on Particles and Nuclei (PANIC-87), Kyoto, Japan, April 1987.

The results of measurement of differential sections of the (^{3}He,t) charge exhange on carbon nuclei and protons are presented. It is shown that the reaction on a nucleus proceeds mainly through the excitation of Δ-isobars. It is impossible to reduce the process of that exciation to the quasifree production of Δ-isobar on an individual intranuclear nucleon and a subsequent free motion of the isobar through nucleus. The collective effects caused by other nucleons are important. 19 refs.; 6 figs.; 1 tab.

38543 (LA-UR—88-1526) Cross-section measurements for radioactive samples. Koehler, P.E.; O'Brien, H.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 24p. (CONF-880546—2; CONF-880546—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010920/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The measurement of (n,p), (n,α) and (n,γ) cross sections for radioactive nuclei is of interest to both nuclear physics and astrophysics. For example, using these reactions, properties of levels in nuclei at high excitation energies, which are difficult or impossible to study using other reactions, can be investigated. Also, reaction rates for both big-bang and stellar nucleosynthesis can be obtained from these measurements. In the past, the large background associated with the sample activity limited these types of measurements to radioisotopes with very long half-lives. The advent of the low-energy, high-intensity neutron source at the Los Alamos Neutron Scattering CEnter (LANSCE) has greatly increased the number of nuclei which can be studied. Examples of (n,p) measurements on samples with half lives as short as fifty-three days will be given. The nuclear physics and astrophysics to be learned from these data will be discussed. Additional difficulties are encountered when making (n,γ) rather than (n,p) or (n,α) measurements. However, with a properly-designed detector, and the high peak neutron intensities now available, (n,γ) measurements can be made for nuclei with half lives as short as several months. Progress on the Los Alamos (n,γ) cross-section measurement program for radioactive samples will be discussed. 39 refs., 7 figs.

38544 (LYCEN—8740) Protons and neutrons contributions to the charge longitudinal response. Alberico, W.M.; Molinari, A.; Chanfray, G.; Ericson, M. (Turin Univ. (IT)). (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753975/JAW.

The charge longitudinal response of nuclei, as measured by inclusive inelastic electron scattering, is investigated in the semiclassical RPA framework. The proton and neutron contributions to the total response are explicitly separated out. It is found that a sizable neutron ejection can be induced by RPA correlations, particularly at low momentum and energy transfer. A comparison of our theory with the experimental data is presented, also in the case of asymmetric nuclei (Nnot =Z). In particular, the differences in the neutron contributions between ^{40}Ca and ^{48}Ca are discussed.

38545 (UCRL—96792) A program to obtain reliable photoabsorption cross sections. Del Grande, N.K.; Tirsell, K.G. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 6p. (CONF-880110—30). NTIS, PC A02;3. Order Number DE88008904/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

A program to obtain reliable photoabsorption cross sections for a broad range of elements has been initiated at Lawrence Livermore National Laboratory. Using well-characterized samples, absolute measurements have been made with overall uncertainties of {+-}10% or less over energy ranges from about 50 eV to several keV, at several synchrotron radiation facilities. More than a dozen elements have been investigated and other measurements are being planned for elements beryllium (Z-4) through uranium (Z-92). Among the interesting phenomena observed are the resonances/enhancements which seem to accompany virtually every inner shell threshold. Specific examples discussed in this paper include carbon, nickel and uranium. Comparison with theory and existing data compilations/data bases indicate the need for substantial theoretical and compilation improvements. 24 refs., 6 figs.

38546 K^+-nucleus scattering and the "swelling" of nucleons in nuclei. Brown, G.E.; Dover, C.B.; Siegel, P.B.; Weise, W. (State University of New York, Stony Brook, New York 11794). *Physical Review Letters;* **60**: No. 26, 2723-2726(27 Jun 1988).

We investigate the utility of the K^+ meson as a probe of effective-size modifications ("swelling") of nucleons in the nuclear medium. The K^+-nucleus elastic and total cross sections are found to be sensitive to the density-dependent effective masses of the vector mesons (rho,ω) whose exchange is responsible for the dominant part of the low-energy K^+-nucleon interaction. This density dependence is estimated in several ways and used to construct a K^+-nucleus optical potential. Such a model is consistent with the $K^+ + ^{12}C$ data at 800 MeVc, and provides a physical picture of the "swelling" mechanism in terms of the medium modifications of the meson cloud of the nucleon.

38547 Oxygen-induced reactions at 60 A GeV and 200 A GeV studied by calorimetry. Sorensen, S.P.; Obenshain, F.E.; Albrecht, R.; Bock, R.; Claesson, G.; Gutbrod, H.H.; Kolb, B.W.; Lund, I.; Schmidt, H.R.; Siemiarczuk, T. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **38**: No. 1/2, 3-14(Apr 1988). (CONF-8708166—).

From 6. international conference on ultra-relativistic nucleus-nucleus collisions; Nordkirchen, F.R. Germany (24 Aug 1987).

Results based on calorimetric measurements are presented from reactions of 60 A GeV and 200 A GeV ^{16}O projectiles with C, Cu, Ag, and Au nuclei. Minimum-bias cross sections are discussed. Energy spectra measured at zero degrees and transverse-energy distributions for the pseudorapidity range 2.4 ≦ eta ≦ 5.5 are shown. An analysis of the average transverse energy in terms of the number of participating nucleons and the number of binary nucleon-nucleon collisions is presented. Estimates of nuclear stopping and of attained energy densities are made.

38548 Emission of complex fragments from highly excited systems produced in ^{93}Nb+^{9}Be and ^{27}Al reactions at EA = 25.4 and 30.3 MeV. Charity, R.J.; Bowman, D.R.; Liu, Z.H.; McDonald, R.J.; McMahan, M.A.; Wozniak, G.J.; Moretto, L.G.; Bradley, S.; Kehoe, W.L.; Mignery, A.C. (Lawrence Berkeley Lab., CA (USA). Nuclear Science Div.; Maryland Univ., College Park (USA). Dept. of Chemistry). *Nuclear Physics [Section] A;* **476**: No. 3, 516-544(18 Jan 1988). Contract AC03-76SF00098.

Complex fragments with atomic numbers intermediate between that of the target and projectile have been detected in the reverse-kinematics reactions of ^{93}Nb plus ^{9}Be and ^{27}Al at bombarding energies of EA = 25.4 and 30.3 MeV. Experimental results from inclusive and coincidence measurements are presented and are used to characterize these fragments as the statistical, binary-decay products of highly excited compound nuclei formed in fusion-like reactions.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

38549 (DOE/ER/40364—1) Nuclear studies with intermediate energy probes: Annual performance report, May 15, 1987-May 14, 1988. Norum, B.E. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Mar 1988. Contract FG05-87ER40364. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007724/JAW.

Nuclear studies with intermediate energy probes have been pursued at LAMPF, IUCF, and NIKHEF-K (Amsterdam). Proton scattering measurements of the calcium isotopes were performed at both LAMPF and IUCF; preliminary measurements of sellected s-d shell nuclei were also made at LAMPF. Analysis of the collected data is underway. Measurements of electron scattering from ^{42}Ca and ^{44}Ca made at NIKHEF-K are also being analyzed. These data are being analyzed in conjunction with data obtained previously at the Bates Linear Accelerator. Initial electron scattering measurements of 4/sup {minus/} excitations in ^{18}O were performed at Bates. Results of previous measurements of ^{16}O and ^{17}O were published. Preparations for experiments at the Saskatchewan Accelerator Laboratory (SAL) and at NIKHEF-K have also been made. The feasibility of performing electron scattering experiments from polarized targets in the SAL storage ring was examined and a proposal for funding of target construction submitted to the U.S. DOE under the University Research Instrumentation Program. Design of a spectrometer is underway. 21 refs., 5 figs.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

38550 (INFN/BE—86-2) Gamma decay of excited complex fragments emitted in the reaction ^{20}Ne+^{60}Ni at 742 MeV. D'Onofrio, A.; Delaunay, B.; Delaunay, J.; Dumont, H.; Gomez del Campo, J.; Bruandet, J.F.; Brondi, A.; Moro, R.; Romano, M.; Terrasi, F. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702089/JAW.

From the observation of excited ^{7}Li and ^{7}Be fragments at backward angles (120 grade centigrades and 150 grade centigrades) in the reaction Ne+Ni at 742 MeV, an emission temperature compatible with that inferred from the slope of particle energy spectra has been obtained. The use of a high resolution Compton suppressed gamma-ray detector has played a crucial role.

38551 Possible evidence for neutrinoless $\beta\beta$-decay with the emission of majorons. Avignone, F.T. III; Brodzinski, R.L.; Miley, H.S.; Reeves, J.H. (Pacific Northwest Lab., Richland, WA (USA)). pp 3 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—).

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

An ultralow background, 135 cm^3 prototype detector has been operated underground for 402 days of counting. The background from primordial radioactivity was lower by factors between 1.5 x 10^3 and 2.5 x 10^4 when compared to commercial low-background detectors. Data from this and from other ^{76}Ge $\beta\beta$-decay experiments were combined in a single spectrum and analyzed for neutrinoless $\beta\beta$-decay with the emission of electrons only. The maximum likelihood 68%-C.L. values for the half-life and Majorana nu mass are 4.1 x 10^{23} yr and 2.4 eV, respectively. The energy spectrum of their detector shows evidence of a shoulder in the vicinity of the $\beta\beta$-decay Q-value which does not fit any probable background scenario. If attributed to neutrinoless $\beta\beta$-decay with Majoron emission, the net count rate corresponds to T$_1$2 = (6 +- 1) x 10^{20} yr and coupling constant g/sub ee/ = (8 +- 1) x 10^{-4}. They are presently attempting to confirm these results with an improved experiment.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

38552 (AD-A—190275/8/XAB) SDIO/IST ultrashort wavelength laser: novel experimental schemes for observing the Moessbauer effect in long-lived nuclear levels. Final report for period ending 31 March 1987. Hoy, G.R. (Old Dominion Univ., Norfolk, VA (USA). Dept. of Physics). Jul 1987. 26p. (PTR—87-6). NTIS, PC A03/MF A01.

The development of gamma-ray lasers (GRASERS) will, in all probability, depend on the utilization of recoillessly emitted gamma rays from nuclear transitions, i.e. the Moessbauer effect (ME). Past research in Moessbauer spectroscopy which relates to GRASERS is briefly reviewed. The nuclear lifetimes, required from practical considerations, may have to be on the order of seconds, if storage and transfer processes prove infeasible. It is not clear that the ME has been observed in such long-lived states. Even if such long-lived states are not needed directly for GRASERS, successful observation of the ME in such a system will answer important questions of line broadening due to field inhomogeneities in single crystals. The author proposes some novel experimental schemes to observe the ME in ^{109}Ag whose relevant lifetime is about 40 seconds. The techniques proposed are: coincidence Moessbauer spectroscopy, conversion-electron Moessbauer spectroscopy, gravitational line sweeping, and gamma-ray self-absorption. Preliminary results using the last technique are presented. Possible future, relevant ME research is discussed.

38553 (CENBG—8713) Measurement of lifetime of Sb high spin states populated by emission of three protons in the reaction ^{58}Ni + ^{54}Fe at 4 MeV by nucleon. Hiel, A. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Jul 1987. 117p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753939/JAW.

The life time of nuclear excited states populated by the ^{112}Xe compound nucleus and corresponding to the 4 Protons and (alpha, 2 protons) reaction channels was experimentally reached by means of the so called "atomic clock method". This method is based on the comparaison between the known lifetime of an inner atomic hole created on the way into the nuclear fusion reaction (^{58}Ni + ^{54}Fe at 4 MeVA) and the nuclear life time to be measured. On line coincidences performed between the gamma rays of a given evaporation residue (ER) and the emitted X rays enable the selection of the atomic vacancies decaying during different steps of the deexcitation channel. Taking advantage of the long lived nuclear converted transitions and using the Doppler shift method, the spurious contamination in the X rays spectrum associated with decay by internal convertion of the nuclear final states is avoided. The main characteristics of this technique are illustrated by measurements for the first time of: - average life time of intermediate nucleus (Sb) in the 4p) reaction channel. This life time was found equal to (7+-4) 10^{-17}s, when the excitation energy of the corresponding ER is lying between 12 and 25 MeV, - a nice dependence of the nuclear life time on the angular momentum and excitation energy of the residual nucleus.

38554 (DOE/ER/40345—1) Triple angular correlations in the decay of /sup 110m/Ag: Annual report. Krane, K.S.; Schulz, N.S. (Oregon State Univ., Corvallis (USA). Dept. of Physics). [1987]. Contract FG06-87ER40345. 27p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009681/JAW.

Double and triple gamma-ray angular correlations are reported for cascades in ^{110}Cd following the decay of ^{110}Ag. The 764-1505-658 keV triple correlation helps to resolve a long-standing ambiguity concerning the E2M1 multipole mixing ratio of the 1505-keV transition. The potential of triple correlations to contribute to nuclear spectroscopy is thereby demonstrated. 12 refs., 8 figs., 1 tab.

38555 (DOE/ER/40345—6) Angular correlations of gamma rays in the decay of ^{109}Pd and ^{111}Pd. Brown, D.E. (Oregon State Univ., Corvallis (USA)). 23 Sep 1987. Contract FG06-87ER40345. 79p. NTIS, PC A05;3. Order Number DE88009577/JAW.

In this work, angular correlation techniques have been used to determine the mixing ratios of several γ-transitions in ^{109}Ag and ^{111}Ag and to make some spinparity assignments for some of the levels in these nuclei. The choice of these two isotopes for study in this work was made for three main reasons: (1) lack of existing information on the electromagnetic properties of these nuclei; (2) unexpectedly large M2E1 mixing ratios had been measured in Bosch et al. and required verification and; (3) the possibility of testing a particle-rotor model, due to De-Shalit, whereby ^{109}Ag and ^{111}Ag can be described as a single p_12 proton coupled to a deformed, even-even core. Zeghib et al. have had considerable success in applying this model to ^{111}Ag recently. More data is needed on level structure and mixing ratios to test fully the validity of this model. In the following, a brief description of the theory of angular correlations is given. Then a detailed description of the automatic data acquisition system for the spectrometer is given. This system was designed specifically to meet the needs of this experiment. Finally, the results of the studies of the two isotopes of interest are detailed. 16 refs., 19 figs., 9 tabs.

38556 (GSI—87-83-Prepr.) Gamow-Teller beta decay of neutron-deficient even isotopes of tin. Barden, R.; Kirchner, R.; Klepper, O.; Rathke, G.E.; Roeckl, E.; Schardt, D.; Plochocki, A.; Rykaczewski, K.; Zylicz, J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej). Dec 1987. 28p. Also published in Z. Phys., A: At. Nuclei (Mar 1988) Vol. 329(3) p. 319-330.

With the use of the ^{58}Ni + ^{50}Cr fusion-evaporation reaction and chemically selective on-line mass separation, the ECβ^+ decay of ^{104}Sn was studied by γ-ray and conversion-electron spectroscopy. In the course of these studies, a new 15.7-s isomeric state of ^{104}In was observed. Reinvestigation of the β-decays of the two heavier even isotopes of tin, produced in the ^{58}Ni + ^{58}Ni reaction and mass separated without chemical discrimination, brought new information on the decay of ^{106}Sn and ^{108}Sn. The Q/sub EC/ values of ^{104}Sn, ^{106}Sn and ^{108}Sn were determined to be 4550(+300-250) keV, 3200 +- 100 keV and < 2270 keV, respectively. In the data analysis, the emphasis is put on the identification of the $0^+ \rightarrow 1^+$ Gamow-Teller β transitions and determination of their strengths. For $^{104-110}$Sn, the total Gamow-Teller strengths are measured to be 20% to 30% of that predicted by the single-particle shell model with the inclusion of pairing correlations and core polarization. Predictions of the decay properties of the as yet unobserved ^{103}Sn and ^{100}Sn are made.

38557 (INIS-mf—11721) Interactions of collective and particle excitations in the nucleus ^{138}Ce. Schmittgen, K.P. (Koeln Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 7 Feb 1987. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753557/JAW.

The nucleus ^{138}Ce was produced by the compound-nucleus reactions ^{139}La(p,2n), E/sub p/ = 18-27 MeV, ^{136}Ba(α,2n), E/sub α/ = 24-25 MeV, and ^{124}Sn(^{16}O,4n), E/sub O/ = 62-74 MeV. By means of these reactions each γ-γ coincidences, angular distributions, conversion electrons, and excitation functions (except the (α,2n) reaction) were measured. A term scheme resulting from these measurement was established. 14 new states and 10 new spins below 3.5 MeV and 13 new states and 6 new spins above 3.5 MeV were determined. A life-time measurement was performed with the (p,2n) reaction at 18 MeV. New isomers with half-lives between 3 ns and 50 ns could not be detected. By means of angular distribution, conversion and excitation function spin and parity of the level at 3539 keV could be fixed to 10^+. By this a reduced transition probability for the 430-keV transition from the 3539-keV level to the 3109-keV level of B(E2) = 0.46(1) $e^2(fm)^4$ respectively 0.01 Weisskopf units results. By means of a Coulomb excitation the reduced transition probability of the ground-state transition in ^{138}Ce was determined to B(E2) = 910(70)$e^2(fm)^4$. (orig.HSI).

38558 (JINR-R—6-87-478) Differences of the nuclear charge radii of rare earth elements with even and odd numbers of neutrons. Gangrskij, Yu.P.; Zemlyanoj, S.G.; Kul'dzhanov, B.K. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702935/JAW.

Submitted to the journal Izv. AN SSSR.

Isotope shifts in optical spectra of Nd, Sm and Gd atoms have been investigated. The experimental method was based on resonance fluorescence of the investigated atoms. The tunable dye-laser was used for atom excitation. Changes in mean-square nuclear charge radii for odd and even rare-earth nuclei were extracted from reported isotope shifts. The dependence of nuclear charge radii odd-even differences on neutron number is discussed. 15 refs.; 1 fig.; 4 tabs.

38559 (LBL—24275) Subthreshold pion production in the reaction ^{139}La + ^{139}La $\rightarrow \pi^{+-}$ + X. Miller, J. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098;AS05-76ER04699. 222p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88008228/JAW.

We have measured charged pion production in the reaction ^{139}La + ^{139}La $\rightarrow \pi^{+-}$ + X at three beam energies (246, 183 and 138 MeVnucleon) below the nucleon-nucleon threshold. Associated multiplicity for charged participants was obtained using a 110-element scintillator multiplicity array. Data were taken over the angular range of 21{degree} to 67{degree} in the laboratory (equivalent to 30{degree} to 90{degree} in the center of mass). Dependence of the spectra upon pion charge, energy and angle, beam energy, system mass and associated multiplicity was investigated. Based on the isotropic angular distibutions and the associated multiplicities for pion production, it appears that subthreshold pions in the range of our experiment are produced predominantly from a source at rest in the center of mass and involving a large number of nucleons. The general character of the subthreshold pion spectra is comparable to previous results above threshold. However, the scaling of the subthreshold pion yield with system mass deviates from the dependence observed in light systems, to an extent which cannot be explained by a simple nucleon-nucleon model. We also found charge dependent structure in the pion spectra, which we analysed in the framework of both Coulomb distortion and clustering models. We conclude that while we did not find clear evidence of collective effects in subthreshold pion production, it would be very worthwhile to conduct a systematic investigation of pion production for all charge states and over a range of angles, system masses and beam energies, below threshold. 170 refs., 78 figs., 10 tabs.

38560 (LBL—25233) New limit on the neutrinoless double beta decay of ^{100}Mo. Krivicich, J.M. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88011908/JAW.

A search for the neutrinoless double beta decay of ^{100}Mo was conducted using thin Mo films and solid state Si detectors. The experiment has collected 3500 hours of data operating underground in a deep silver mine (3290 M.W.E.). Only one event was found to be consistent with neutrinoless double beta decay. Using this one event, a limit of $\geq 1 \times 10^{22}$ years (1 σ) is set on the ^{100}Mo half-life. This is approximately five times larger than the best previous ^{100}Mo limit.

38561 Deformation-driving properties of the *vi*/sub 13/2/ [660](1/2$^+$ intruder orbital for A$\sim$130 nuclei. Paul, E.S.; Ma, R.; Beausang, C.W.; Fossan, D.B.; Piel W.F. Jr.; Shi, S.; Xu, N.; Zhang, J. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review Letters;* **61**: No. 1, 42-45(4 Jul 1988).

Several rotational-band structures have recently been observed in mass A$\approx$130 nuclei, built on multiquasiparticle states of enhanced quadrupole deformation, the so-called superdeformed states ($\beta \approx 0.4$). In /sup 137/Sm, a decoupled band built on the *vi*/sub 13/2/[660](1/2$^+$ single-quasineutron orbital, intruding from two

oscillator shells above with a predicted $\beta \cong 0.35$, was observed to low spin and excitation energy. The role of this β-driving $\nu i_{13/2}$ orbital, which showed a 50% enhanced moment of inertia, is discussed in terms of the superdeformation in this mass region.

38562 Evidence for superdeformation in ^{148}Gd. Drigert, M.W.; Garg, U.; Janssens, R.V.F.; Holzmann, R.; Chasman, R.R.; Ahmad, I.; Dichter, B.K.; Emling, H.; Khoo, T.L.; Ma, W.C. (Notre Dame Univ., IN (USA);Argonne National Lab., IL (USA)). *Physics Letters [Section] B;* 201: No. 2, 223-227(4 Feb 1988). Contract AC02-76ER01672;W-31-109-ENG-38.

γ-γ transition energy correlation measurements were performed in ^{148}Gd using Compton-suppressed Ge detectors. A broad first-ridge was observed for $1.00 < E_\gamma < 1.42$ MeV. The deduced moment of inertia $\phi^{(2)} = 78$ Planck constant^2 MeV^{-1} is consistent with superdeformation in ^{148}Gd. The results can be explained by cranked Strutinsky calculations.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

38563 (BNL—41121) Transverse energy distribution, charged particle multiplicities and spectra in ^{16}O--nucleus collisions. Sunier, J.W. (Brookhaven National Lab., Upton, NY (USA)). 26 Nov 1987. Contract AC02-76CH00016. 8p. (CONF-8708166—5). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009847/JAW.

From 6. international conference on ultra-relativistic nucleus-nucleus collisions; Nordkirchen, F.R. Germany (24 Aug 1987).

The HELIOS (High Energy Lepton and Ion Spectrometer) experiment, installed at the CERN Super Proton Synchrotron, proposes to examine in detail the physical properties of a state of high energy created in nuclei by ultra-relativistic nucleus-nucleus collisions. It is generally believed that, at high densities or temperatures, a phase transition to a plasma of quark and gluons will occur. The dynamic of the expansion of such a plasma and its subsequent condensation into a hadron gas should markedly affect the composition and momentum distribution of the emerging particles and photons. The HELIOS experimental setup therefore combines 4π calorimetric coverage with measurements of inclusive particle spectra, two particle correlations, low and high mass lepton pairs and photons. The emphasis is placed on transverse energy flow (E_T) measurements with good energy resolution, and the ability to trigger the acquisition of data in a variety of E_T ranges, thereby selecting the impact parameter or the violence of the collisions. This short note presents HELIOS results, for the most part still preliminary, on ^{16}O--nucleus collisions at the incident energies of 60 and 200 GeV per nucleon. The E_T distributions from Al, Ag and W targets are discussed and compared to the associated charged particle multiplicities from W. Charged particle and (converted) photon spectra measured with the external magnetic spectrometer are compared for ^{16}O + W and p + W collisions at 200 GeV per nucleon.

38564 (CONF-880260—7) Experimental studies of quasi-fission reactions. Back, B.B.; Glagola, B.G.; Henderson, D.; Kaufman, S.B.; Keller, J.G.; Sanders, S.J.; Videbaek, F.; Wilkins, B.D. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009967/JAW.

From 5. winter workshop on nuclear dynamics; Sun Valley, ID, USA (22 Feb 1988).

A large body of experimental data on these fission-like processes have become available in recent years using a number of different target-projectile combinations. None of these experimental studies are specifically addressing the question of entrance channel effects. These effects are expected to play an important role if the dynamics in the approach phase of the reaction is responsible for the occurrence of quasi-fission. An alternate interpretation in terms of the disappearance of the fission barrier at large partial waves, which is entirely a property of the completely fused system independent of the formation process, has also been proposed. In order to address these questions we have studied the system ^{214}Th via three different entrance channels, namely ^{32}S{plus}^{182}W, ^{48}Ti{plus}^{166}Er and ^{60}Ni{plus}^{154}Sm. The analysis of the ^{48}Ti{plus}^{166}Er data is, as yet, incomplete and we shall therefore report only on the results of the ^{32}S{plus}^{182}W and ^{60}Ni{plus}^{154}Sm reactions in this paper. 4 refs., 3 figs.

38565 (CONF-880260—10) Very-high energy (E → E/sub beam/) light particle production near 0° in heavy-ion collisions, E/A ≦ 40 MeV/u. Shaheen, S.; Becchetti, F.D.; Roberts, D.; Jaenecke, J.; Schulman, P.; Stern, R.; Nadasen, A.; Kovar, D. (Michigan Univ., Ann Arbor (USA). Dept. of Physics; Michigan Univ., Dearborn (USA). Dept. of Natural Sciences; Argonne National Lab., IL (USA)). Feb 1988. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011985/JAW.

From 5. winter workshop on nuclear dynamics; Sun Valley, ID, USA (22 Feb 1988).

Studies of heavy-ion collisions at E/A ~ 10 MeV/u to 20 MeV/u with the production of nucleons and other particles at forward angles with velocities several times that of the projectile have been observed by many groups (TAM, ORNL, MSU, HMI). This is usually attributed to projectile fragmentation with Fermi motion of the light particle which is often described by a source temperature T_s, accounting for the additional velocity component. However, experiments reported by Borcea et al. and those done at the Hahn-Meitner Institute (VIKSI) have suggested that high-energy alpha particles observed near theta = 0° in ^{20}Ne-induced collisions, E/A ≦ 20 MeV/u, may arise from mechanisms such as cluster transfer reactions. Here we report observation of a similar phenomenon with a variety of projectiles (Z ≧ 8), E/A = 9 to 40 MeV/u.

38566 (DOE/ER/40109—6) Quadrupole moments and g-factors of low-lying bands in odd-A-nuclei (150 < A < 190). Rieckert, V. (Oregon State Univ., Corvallis (USA). Dept. of Physics). 8 Sep 1987. Contract AT06-83ER40109. 102p. NTIS, PC A06;3. Order Number DE88010190/JAW.

The static and dynamic electric quadrupole moments of even-even and odd-A nuclei with 150 < A < 190 have been compiled and analyzed in a systematic way, in order to extract the best set of intrinsic quadrupole moments Q_0. The intrinsic quadrupole moments of the odd-A nuclei have been used together with a compilation of static and transitional magnetic dipole moments of those nuclei to deduce a consistent set of collective rotational g-factors g_R and intrinsic g-factors g_K. A comparison between the rotational g-factors obtained from this compilation and theoretical values based on the cranking model shows good agreement between the two. The intrinsic g-factors have been compared with an estimate based on the Nilsson wave functions, and effective spin g-factors have been extracted. The latter display a spread of values somewhat larger than predicted by a previous calculation of the spin polarization effect. 26 refs., 10 figs., 9 tabs.

38567 (IPNO-DRE—87-34) Structure of doubly-odd nucleus ^{184}Ir from the decay of ^{184}Pt. Ben Braham, A.; Bourgeois, C.; Kilcher, P.; Roussiere, B.; Sauvage, J.; Kreiner, A.J.; Porquet, M.G. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753484/JAW.

States of ^{184}Ir populated through the β^+EC decay of ^{184}Pt, were studied using mass-separated sources and on-line γ-ray and e^- spectroscopy techniques. A rather complete low-spin level scheme is established. Negative and positive parity structures are interpreted within the two-quasiparticle-plus-rotor model.

38568 (JINR—E-1-87-350) Target residues from the reactions of 9 GeVc protons and deuterons with ^{181}Ta. Kozma, P.; Kliman, J.; Leonard, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702131/JAW.

Submitted to the journal Czech. J. Phys. B.

The production of radioactive nuclides in the reactions of 9 GeVc protons and deuterons with ^{181}Ta has been investigated at the Dubna synchrophasotron. The production cross section of target fragments with 24 ≦ A ≦ 178 were determined by off-line

gamma-ray spectroscopy. Charge dispersions and mass yields are deduced from these data. The results are discussed in terms of the concepts of high-energy nuclear physics. 15 refs.; 6 figs.; 5 tabs.

38569 **(JINR-R—1-87-442) Two-proton correlations and sizes of proton emission region in pTa interactions at 10 GeV/c.** Agakishiev, G.N.; Armutlijski, D.D.; Akhababyan, N.O. and others. (AN Azerbajdzhanskoj SSR, Baku. Inst. Fiziki; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702924/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Two-particle correlations between secondary protons with small relative momenta in pTa interactions are studied in order to obtain the values of radius of their emission region at initial momentum of 10 GeVc. The results were compared with those on two-proton correlations in interactions of light nuclei. A=8(p, d, a, C) with carbon nuclei. The radii of proton emission region are determined for different intervals of average total and transverse momenta of proton pairs. As a result of comparing the sizes of the emission regions of protons from pTa and pA interactions it turned out that for <p>/sub min/ >or approx. 0.4 GeVc (<p>/sub min/=12chemical bondp-vector$_1$+p-vector$_2$chemical bond/sub min/) the radii of the emission region are less than those of target nuclei and they coincide for both types of interactions. This result might be an indication to the emission of fast protons resulting from the interaction of the projectile with a definite part of target-nucleus which weakly depends on the size of a projectile. 13 refs.; 7 figs.; 3 tabs.

38570 **(UCRL—97891-Rev.1) Measurement of atomic oscillator strengths using pulsed single frequency dye lasers.** Haynam, C.; Comaskey, B.; Johnson, M.; Paisner, J.; Worden, E. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 8p. (CONF-880435—20-Rev.1). NTIS, PC A02;3. Order Number DE88011350/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

We have used two methods to measure the oscillator strength of the transition between the ground and 17992 cm/sup {minus/1} level in ^{174}Yb. In the first technique we observe the population oscillations of a two-level system due to resonant laser excitation. The measurement of the oscillation frequency vs integrated laser electric field or pulse area allows determination of the transition oscillator strength. The second method is similar to the inverse hook method developed by Wijngaarden et al. The measurement of the population oscillation versus laser fluence and detuning permits the determination of oscillator strength. In both cases two-step photoionization is used to detect excited state population variations. 5 refs., 14 figs.

38571 **Structural changes along and above the yrast line of /sup 154/Dy.** Ma, W.C.; Quader, M.A.; Emling, H.; Khoo, T.L.; Ahmad, I.; Daly, P.J.; Dichter, B.K.; Drigert, M.; Garg, U.; Grabowski, Z.W.; and others. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **61**: No. 1, 46-49(4 Jul 1988).

States in /sup 154/Dy have been located up to I/sup π/ = 48^+ and their lifetimes measured. Marked structural changes occur along the yrast line with a transition from prolate to oblate shape, followed by an unexpected return to moderate collectivity at the highest spins. Structural changes with increasing energy above the yrast line are also observed.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

38572 **(CONF-880260—4) Results from CERN experiment WA80.** Plasil, F.; Albrecht, R.; Awes, T.C.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Dragon, L.; Ferguson, R.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. (CONF-880260—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008372/JAW.

From 5. winter workshop on nuclear dynamics; Sun Valley, ID, USA (22 Feb 1988).

The two primary goals of the WA80 collaboration are to survey nucleus-nucleus collisions at 60 and 200 GeVnucleon and to compare the results to those obtained from proton-nucleus interactions and to search for evidence that a quark-gluon plasma has been formed or that some similar phase transition has taken place. One of the ways to pursue the first goal is by means of forward and transverse energy measurements. These relate to important quantities such as the degree of nuclear stopping, the magnitude of attained energy densities, and the level at which collective effects manifest themselves. These measurements and their interpretation were discussed during the oral presentation at this meeting for both ^{16}O- and ^{32}S-induced reactions. Since the ^{16}O results are now published, we present here only the preliminary unpublished ^{32}S transverse energy distributions. In addition, we show sample results obtained with the single-arm photon spectrometer, SAPHIR, and with the Plastic Ball. 8 refs., 3 figs.

38573 **(CONF-8806117—3) Excitation and photon decay of giant multipole resonances - the role and future of medium-energy heavy ions.** Bertrand, F.E.; Beene, J.R.; Horen, D.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011842/JAW.

From 3. international conference on nucleus nucleus collisions; Saint-Malo, France (6 Jun 1988).

Inelastic scattering of medium energy heavy ions provides very large cross sections and peak-to-continuum ratios for excitation of giant resonances. For energies above about 50 MeV/nucleon, giant resonances are excited primarily through Coulomb excitation, which is indifferent to isospin, thus providing a good probe for the study of isovector giant resonances. The extremely large cross sections available from heavy ion excitation permit the study of rare decay modes of the photon decay of giant resonances following excitation by 22 and 84 MeV/nucleon ^{17}O projectiles. The singles results at 84 MeV/nucleon yield peak cross sections for the isoscalar giant quadrupole resonance and the isovector giant dipole resonance of approximately 0.8 and 3 barns/sr, respectively. Data on the ground state decay of the isoscalar giant quadrupole and isovector giant dipole resonances are presented and compared with calculations. Decays to low-lying excited states are also discussed. Preliminary results from an experiment to isolate the ^{208}Pb isovector quadrupole resonance using its gamma decay are presented.

38574 **(GSI—87-59-Prepr.) On the production of superheavy elements and the limitations to go beyond.** Armbruster, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Sep 1987. 45p. (CONF-8706234—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753377/JAW.

From International school of physics Enrico Fermi: course on trends in nuclear physics; Varenna, Italy (23 Jun 1987).

The work I present has been achieved by a group of physicists, the 'SHIPPERS' of GSI Darmstadt working together since about 10 years. All the experiments are performed using the strong beam of the 'UNILAC' accelerator to produce evaporation residues (EVR), the velocity selector 'SHIP' to separate the EVR's from the primary beam, and an implantation technique allowing to indentify single atoms by their α-decay genetics. A comprehensive review of our work was given recently. (orig./HSI).

38575 **(GSI—87-82-Prepr.) Photon and neutral pion distributions in 60 and 200 A.GeV ^{16}O + nucleus and proton + nucleus reactions.** Albrecht, R.; Bock, R.; Claesson, G.; Gutbrod, H.H.; Kolb, B.W.; Lund, I.; Schmidt, H.R.; Siemiarczuk, T.; Awes, T.C.; Baktash, C. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Oak Ridge National Lab., TN (USA); Muenster Univ. (Germany, F.R.); Lawrence Berkeley Lab., CA (USA); Lund Univ. (Sweden); Tennessee Univ., Knoxville (USA)). Dec 1987. 16p. Also published in Phys. Lett., B (11 Feb 1988) v. 201(3) p. 390-396.

Transverse momentum (p/sub T/) distributions of inclusive photons and neutral pions at midrapidity are measured with a lead glass calorimeter in 60 and 200 A.GeV ^{16}O + nucleus and proton + nucleus reactions. The variation of the average transverse momentum is investigated as function of centrality, determined by measurements of the remaining energy of the projectile and the charged particle multiplicity. For small values of the entropy, deduced from the multiplicity density, an increase in average p/sub T/ is observed levelling off for larger values of entropy. The target-mass and energy dependence of π^0 p/sub T/ distributions are presented.

38576 **(IPNO-DRE—87-37) High spin levels in the ^{199}Pb and ^{200}Pb isotopes.** Pautrat, M.; Lagrange, J.M.; Dionisio, J.S.; Vieu, C.; Vanhorenbeeck, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753485/JAW.

The de-excitation of the ^{200}Pb and ^{199}Pb isotopes, produced through the $^{186}W(^{18}O\ 4n, 5n)$ reactions, is investigated using γ-ray and conversion electron spectroscopy. The conversion coefficients are measured and the multipolarities deduced for a great number of transitions. The e^--γ and γ-γ coincidences and the half-life measurements lead to several new levels in both level schemes: the ^{200}Pb one is extended up to nearly 7 MeV, where an isomer is found. The experimental results are compared to those of microscopic calculations, performed in a two or three quasi-particle approximation, using a surface delta interaction with a reduced pairing component.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

38577 **(CONF-880546—14) R-matrix analyses of the ^{235}U and ^{239}Pu neutron cross sections.** Derrien, H.; de Saussure, G.; Larson, N.M.; Leal, L.C.; Perez, R.B. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France); Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1988. Contract AC05-84OR21400. 14p. (CONF-880546—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011015/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The resonance parameter analysis code SAMMY was used to perform consistent resonance analyses of several ^{235}U and ^{239}Pu fission and capture cross section and transmission measurements up to 110 eV for ^{235}U and up to 1 keV for ^{239}Pu. The method of analysis, the measurement selection and the results are briefly outlined in this paper.

38578 **(INIS-mf—11719) Studies on the ternary fission of ^{252}Cf with the detector DIOGENES.** Schall, P. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik). Jun 1987. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753555/JAW.

In this thesis on a measurement of the ternary fission of ^{252}Cf is reported. The relevant parameters for the mass determination energies and angles between the fragments were measured in coincidence. During a measurement time of 100 days 3 events were found in which each of the 3 angles between the fragments lies in an interval of 120^0 +- 20^0. Because these 3 events exhibited no symmetric mass distribution as upper limit for the ratio of symmetric ternary to binary fissions $< 2 \times 10^{-9}$ results. For the asymmetric ternary fission an upper limit of 8×10^{-8} was found.

38579 **(LA—10979-MS) Plutonium-241 half-life determination by high-resolution gamma-ray spectrometric measurement of $^{241}Pu/^{239}Pu$ ratios.** Likes, R.N.; Parker, J.L.; Goldman, A. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 63p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010470/JAW.

A new method based upon high-resolution gamma-ray spectroscopy has estimated the half-life of ^{241}Pu to be 14.355 yr with a standard deviation of 0.004 yr. During a period of approximately 10 yr, quantities proportional to the $^{241}Pu/^{239}Pu$ mass raio were periodically determined by gamma-ray spectroscopy for 13 plutonium samples. Because spectra were acquired with both planar and coaxial germanium gamma-ray detectors, and because several mass ratios can be extracted from each gamma-ray spectrum, a total of 156 sets of time-dependent ratios were acquired, each yielding a half-life value. The procedure used to determine the time-dependent mass ratios makes them essentially independent of the size, shape, chemical composition, packaging, and isotopic distribution of the plutonium samples, and of the counting geometry including external filtering and of detector efficiency. The quoted result was obtained from a linear unweighted least-squares fit to all 156 sets of ratios comprising about 1000 data points, which was assumed to follow a fixed-effect, cross-classification analysis-of-covariance model. 7 refs., 19 figs., 5 tabs.

38580 **(LA—11151-MS) Background radiation from fission pulses.** England, T.R.; Arthur, E.D.; Brady, M.C.; LaBauve, R.J. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 81p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010184/JAW.

Extensive source terms for beta, gamma, and neutrons following fission pulses are presented in various tabular and graphical forms. Neutron results from a wide range of fissioning nuclides (42) are examined and detailed information is provided for four fuels: ^{235}U, ^{238}U, ^{232}Th, and ^{239}Pu; these bracket the range of the delayed spectra. Results at several cooling (decay) times are presented. For β^- and γ spectra, only ^{235}U and ^{239}Pu results are given; fission-product data are currently inadequate for other fuels. The data base consists of all known measured data for individual fission products extensively supplemented with nuclear model results. The process is evolutionary, and therefore, the current base is summarized in sufficient detail for users to judge its quality. Comparisons with recent delayed neutron experiments and total β^- and γ decay energies are included. 27 refs., 47 figs., 9 tabs.

38581 **Uncertainties of particle emission probabilities.** Browne, E. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Instruments and Methods in Physics Research;* **265**: No. 3, 541-547(15 Mar 1988). Contract AC03-76SF00098.

This paper presents analytical methods for calculating uncertainties of particle emission probabilities, and shows how they are affected by decay-scheme normalization procedures. The equations have been derived with standard mathematical error-propagating techniques, using first-order approximations in Taylor series expansions of emission probabilities.

38582 **Measurement of 14.7 neutron-activation cross-sections for fusion.** Meadows, J.W.; Smith, D.L.; Bretscher, M.M.; Cox, S.A. (Argonne National Lab., IL (USA)). *Annals of Nuclear Energy;* **14**: No. 9, 489-497(1987).

The activation method has been used to measure 14.7 MeV cross sections for the following 21 reactions which are important for fusion-energy applications: $^7Li(n,n't)^4He$, $^{27}Al(n,p)^{27}Mg$, $^{27}Al(n,\alpha)^{24}Na$, $Si(n,X)^{28}Al$, $Ti(n,X)^{46}Sc$, $Ti(n,X)^{47}Sc$, $Ti(n,X)^{48}Sc$, $^{51}V(n,p)^{51}Ti$, $^{51}V(n,\alpha)^{48}Sc$, $Cr(n,X)^{52}V$, $^{55}Mn(n,2n)^{54}Mn$, $^{54}Fe(n,\alpha)^{51}Cr$, $Fe(n,X)^{56}Mn$, $^{59}Co(n,p)^{59}Fe$, $^{59}Co(n,2n)^{58}Co$, $^{59}Co(n,\alpha)^{56}Mn$, $^{58}Ni(n,2n)^{57}Ni$, $^{65}Cu(n,p)^{65}Ni$, $^{65}Cu(n,2n)^{64}Cu$, $Zn(n,X)^{64}Cu$, and $^{64}Zn(n,2n)^{63}Zn$. The results of this investigation are compared with corresponding recently evaluated cross-section values. Within the combined errors of the measured and evaluated results, the agreement is generally quite acceptable although some problem areas remain to be resolved. Significant improvements in the knowledge of the cross sections are achieved as a result of the present investigation for the reactions $Ti(n,X)^{47}Sc$, $^{59}Co(n,p)^{59}Fe$ and $^{65}Cu(n,p)^{65}Ni$. In the case of $^7Li(n,n't)^4He$, the present meas-

urement supports a recent evaluation in which a number of other n+^{7}Li processes were simultaneously considered in conjunction with neutron-induced tritium production.

38583 Heavy ion reactions with transplutonium elements. Hoffman, D.C. (Lawrence Berkeley Lab., CA (USA)). pp 30 of 194th national meeting of the American Chemical Society, Division of Nuclear Chemistry and Technology. Washington, DC; American Chemical Society (1987). (CONF-8708244—). Contract AC03-76SF00098.

From American Chemical Society Division of Nuclear Chemistry and Technology meeting; New Orleans, LA, USA (30 Aug 1987).

Fusion reactions between light heavy ions and heavy actinide targets have been widely used to make new transplutonium isotopes and to extend the known elements to atomic number 106. However, because of the rather high excitation energies of the compound nuclei produced in this way, severe losses from prompt fission and particle emission may occur, resulting in extremely small production cross sections for the desired products. Recently, transfer reactions between heavy ions and transplutonium element targets such as Cm-248, Bk-249, Cf-249, and Es-254 have been studied. Use of these targets together with the neutron-rich projectiles O-18 and Ne-22 has been shown to be a viable method for producing neutron-rich isotopes of elements up to 4 protons heavier than the target. However, extension of these studies to Ca-48 which has a still higher N/Z ratio, shows that it is no more effective than the lighter projectiles. Results of recent studies will be reviewed.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 38382, 38410, 38417, 38419, 38432, 38442, 38455, 38464, 38482, 38483, 38484, 38525, 38526, 38541, 38549, 38549, 38555, 38564, 38577, 38577

38584 (AD-A—190104/0/XAB) Square-well potential by an algebraic approach. Kais, S.; Levine, R.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). Dec 1986. 7p. NTIS, PC A02/MF A01.

Pub. in Physical Review A, Vol. 34, No. 6, 4615-4620(Dec 1986).

This paper provides an algebraic approach to the celebrated quantum-mechanical problem of a particle in a box. There are two primary reasons for such a formulation. The first is that the potential and therefore the spectrum are quite anharmonic. Hence, simpler algebraic techniques were the Hamiltonian is one of the group generators, which lead to, at best, a quasi-harmonic spectrum, will just not work for this potential. Systematic methods are, in principle, available for handling anharmonic systems. Also, model algebraic Hamiltonians which are bilinear in the generators have recently been extensively employed in both nuclear and molecular physics. It is therefore of interest to see whether these techniques will work for this benchmark problem.

38585 (BNL—41259) Transition probabilities and static moments in transitional nuclei. Wolf, A.; Casten, R.F. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-8804119—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012132/JAW.

From International workshop on nuclear structure of the zirconium region; Bad Honnef, F.R. Germany (24 Apr 1988).

Electromagnetic transition probabilities and static moments of excited nuclear states are known to be good probes of nuclear structure. Therefore, a systematic analysis of the large amount of existing experimental data for these observables is expected to provide valuable information about the respective isotopes. It is the purpose of this talk to show that a combined analysis of static magnetic moments of 2_1^+ states and B(E2) transition probabilities for even-even nuclei can be used to obtain effective numbers of valence nucleons. This kind of information is of particular interest in cases where subshell closures are found. For example, it is well known that for the transitional nuclei in the A = 150 region the Z = 64 subshell is active when the number of neutrons N < 90, but disappears for N ≧ 90. A similar situation exists in the A = 100 region, where the Z = 38 subshell is active for N ≦ 58. In the following sections we present the method by which effective numbers of valence protons and neutrons can be deduced from B(E2) and g-factor data, and show applications of this method to the A = 150 and A = 100 transitional regions. Part of these results were recently published.

38586 (CONF-880386—6) Relativistic description of deformed nuclei. Price, C.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012033/JAW.

From International conference on spin-observables in nuclear physics; Telluride, CO, USA (14 Mar 1988).

The author has shown that relativistic Hartree calculations using parameters that have been fit to the properties of nuclear matter can provide a good description of both spherical and axially deformed nuclei. The quantitative agreement with experiment is equivalent to that which was obtained in non-relativistic calculations using Skyrme interactions. The equilibrium deformation is strongly correlated with the size of the spin-orbit splitting, and that parameter sets which give roughly the correct value for this splitting provide the best agreement with the quadrupole moments in the s-d shell. Finally, for closed shell +/- 1 nuclei, it was shown that the self-consistent calculations are able to reproduce the experimental magnetic moments. This was not possible in relativistic calculations which include only the effects of the valence orbital.

38587 (CONF-880546—16) Resonance parameter analysis with SAMMY. Larson, N.M.; Perey, F.G. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011405/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The multilevel R-matrix computer code SAMMY has evolved over the past decade to become an important analysis tool for neutron data. SAMMY uses the Reich-Moore approximation to the multilevel R-matrix and includes an optional logarithmic parameterization of the external R-function. Doppler broadening is simulated either by numerical integration using the Gaussian approximation to the free gas model or by a more rigorous solution of the partial differential equation equivalent to the exact free gas model. Resolution broadening of cross sections and derivatives also has new options that more accurately represent the experimental situation. SAMMY treats constant normalization and some types of backgrounds directly and treats other normalizations and/or backgrounds with the introduction of user-generated partial derivatives. The code uses Bayes' method as an efficient alternative to least squares for fitting experimental data. SAMMY allows virtually any parameter to be varied and outputs values, uncertainties, and covariance matrix for all varied parameters. Versions of SAMMY exist for VAX, FPS, and IBM computers.

38588 (CONF-880766—1) Condensation of (e$^+$e/sup {minus/}) due to short-range, non-central attractive forces. Wong, Cheuk-Yin. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011018/JAW.

From 5. international conference on clustering aspects in nuclear and subnuclear systems; Kyoto, Japan (25 Jul 1988).

A discussion of quasi-stable composite e$^+$e/sup {minus/} interactions as an explanation for strong positron lines in heavy ion reactions is given. 4 refs., 1 fig.

38589 (CONF-880766—2) Interaction of a neutral composite particle with a strong Coulomb field. Wong, Cheuk-Yin. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011017/JAW.

From 5. international conference on clustering aspects in nuclear and subnuclear systems; Kyoto, Japan (25 Jul 1988).

The author discusses the interaction of the quasi-composite (e/sup {plus/}e/sup {minus/}) system with an external electromagnetic field. This problem addresses the question of the origin of strong positron lines in quasi-elastic heavy-ion reactions. 3 refs.

38590 (CONF-8804125—1) Drilling holes through nuclei, helium drops, and fermi cases. Pieper, S.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010014/JAW.

From Computational atomic and nuclear physics at one gigaflop conference; Oak Ridge, TN, USA (14 Apr 1988).

The probability of finding a specified number of nucleons in a cylinder passing through a nucleus is calculated by Monte Carlo techniques. The resulting distribution is compared to several analytical forms. The distributions are used to compute the distribution of transverse energy production in ultra-relativistic proton-nucleus collisions. 4 refs., 7 figs.

38591 (CONF-8805140—1) Origin of anomalous positron peaks in heavy-ion reactions. Wong, C.Y. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88011388/JAW.

From International conference on medium- and high-energy nuclear physics; Taipei, Taiwan (23 May 1988).

Unknown neutral objects, which decay into an electron and a positron with sharp energies, are found to be produced in heavy-ion reactions. The author discuss the possible origins of these objects and examine phenomenologically the consequences of a supercritical interaction between an electron and a positron due to their short-range non-central electromagnetic interactions. We study how an (e^+e^-) composite particle may be coupled to a strong nuclear Coulomb field.

38592 (CONF-8805140—3) Light-front dynamics of elastic electron-deuteron scattering. Coester, F. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012056/JAW.

From International conference on medium- and high-energy nuclear physics; Taipei, Taiwan (23 May 1988).

Measurements of the deuteron form factors over a wide range of momentum transfer can provide important clues to the role of subnucleon degrees of freedom in nuclear dynamics. For a meaningful calculation of the form factors it is essential that the current density operators and the deuteron wave function transform under Lorentz transformations in a mutually consistent manner. Standard nucleon-nucleon interactions can be used to construct unitary representations of the Poincare group on the two-nucleon Hilbert space. Deuteron wave functions represent eigenstates of the four-momentum operator. Existing parameterizations of measured single-nucleon form factors are used to construct a conserved covariant electromagnetic current operator. The light-front symmetry of the representation allows a clean separation of the effects of one- and two-body currents for arbitrary momentum transfers. Comparison with data indicates that for $Q^2 <$ GeV^2 the elastic cross sections are not dominated by two-body currents.

38593 (CONF-8805142—1) Nuclear dependence of parton distributions. Close, F.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011845/JAW.

From 3. conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The author reviews the emerging information on the way quark, antiquark, and gluon distributions are modified in nuclei relative to free nucleons. He placed particular emphasis on Drell-Yan and phi production on nuclei and caution against premature use of these as signals for quagma in heavy-ion collisions.

38594 (CONF-8806167—1) How well do we understand quasi-elastic reactions at energies close to the barrier. Rehm, K.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012012/JAW.

From Symposium on heavy ion interactions around the Coulomb Barrier; Padova, Italy (1 Jun 1988).

In collisions between too heavy nuclei a wide spectrum of different reaction modes is observed covering the range from simple processes like elastic scattering to complicated multistep transfers and fusion. On the theoretical side heavy ion reactions are usually analyzed using models that were developed first for light ion induced reactions: the optical model for elastic scattering and the DWBA for more inelastic processes like transfer and inelastic scattering. Some of the assumptions going into these approximations, however, are not valid for heavy ion induced reactions. The region between fusion and quasi-elastic reactions is not well understood theoretically. This region is associated with deep inelastic collisions, which are complex multiparticle reactions involving transfer of several protons and neutrons. In this paper, the author discusses to what extent experiments in the field of quasi-elastic scattering are understood within the framework of various theoretical models and in what areas more work is needed.

38595 (DOE/ER/40109—1) g/sub R/ and g/sub K/ factors in deformed nuclei. Krane, K.S.; Teich, W.G. (Oregon State Univ., Corvallis (USA). Dept. of Physics). 1984. Contract AT06-83ER40109. 14p. (CONF-8408123—3). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010194/JAW.

From International symposium on nuclear orientation and nuclei far from stability; Leuven, Belgium (28 Aug 1984).

The static and dynamic magnetic dipole moments of odd-mass and even-mass nuclei with $150 < A < 190$ have been compiled and analyzed in a systematic way, in order to extract the best set of collective rotational g-factors g/sub R/ and intrinsic g-factors g/sub K/. 2 refs., 4 tabs.

38596 (DOE/ER/40109—2) Summary remarks and prospects for on-line nuclear orientation. Krane, K.S.; Hamilton, J.H. (Oregon State Univ., Corvallis (USA). Dept. of Physics; Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics). 1984. Contract AT06-83ER40109;AS05-76ER05034. 16p. (CONF-8408123—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010193/JAW.

From International symposium on nuclear orientation and nuclei far from stability; Leuven, Belgium (28 Aug 1984).

This paper reviews the use of on-line nuclear orientations as a method for determining hyperfine structure. Historical developments and future prospects for the technique are presented. The role that this technique can play in nuclear spectroscopy and the study of nuclei far from the beta stability are outlined.

38597 (DOE/ER/40109—5) Electromagnetic moments of odd-A deformed nuclei. Krane, K.S.; Rieckert, V.; Teich, W.G. (Oregon State Univ., Corvallis (USA). Dept. of Physics). 1987. Contract AT06-83ER40109. 5p. (CONF-8708123—4). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010192/JAW.

From International conference on nuclear structure through static and dynamic moments; Melbourne, Australia (25 Aug 1987).

Based on a new compilation of static and transitional electromagnetic moments from the literature, a consistent set of rotational and intrinsic g-factors gR and gK has been deduced and compared with theoretical calculations. 10 refs., 4 tabs.

38598 (DOE/ER/40286—T1) Configuration space Faddeev calculations. Progress report, 1 January 1987-31 December 1987. Payne, G.L.; Klink, W.H.; Polyzou, W.N. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jan 1988. Contract FG02-86ER40286. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011907/JAW.

The detailed study of few-body systems provides one of the most sensitive tools for studying nuclear physics at subnucleon distance scales. For these systems the model equations can solved numerically with errors less than the experimental uncertainties. The author have used these systems to investigate the size of relativistic effects, the role of meson-exchange currents, and the importance of quark degrees of freedom in the nucleus. Detailed calculations of the electromagnetic form factors of the deuteron have been done using a front-form formulation of relativistic quantum mechanics. The structure of the most general Poincare covariant electromagnetic current operators and general tensor operators consistent with the dynamical constraints of special relativity was derived. The techniques for constructing scattering amplitudes for multiparticle

production reactions have been developed. We have completed a detailed study of the properties of the bound trinucleon system. The solution of the time-dependent Schroedinger in configuration space has been studied. Finally, new computational and analytic tools have been developed.

38599 **(EGG—2533) VAXGAP: A code for the routine analysis of gamma-ray pulse-height spectra on a VAX computer.** Killian, E.W.; Hartwell, J.K. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1988. Contract AC07-76ID01570. 52p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011702/JAW.

This report describes the analysis algorithms and techniques used in the VAX Gamma-Ray Analysis Program (VAXGAP) at the Idaho National Engineering Laboratory (INEL). VAXGAP is a collection of computer programs for the analysis of gamma-ray pulse-height spectra. It operates on a Digital Equipment Corporation VAX computer, using the VMS operating system. Linear and nonlinear peak fitting techniques are used to calculate photopeak areas, which in turn are used to determine the concentration of gamma-ray emitting radionuclides in many different types of samples--from {open←quotes}hot{close←quotes} samples, collected from the primary coolant water of operating reactors, to very low-level environmental samples. VAXGAP is user friendly and provides laboratory technicians and spectroscopists with analysis results in a rapid and accurate manner with a minimal investment in computer hardware. On a VAX-750 computer, VAXGAP takes less than a minute to perform a typical spectrum analysis. VAXGAP programs are menu-driven and the user interface to the analysis functions is simple. Use of VAXGAP does not require a detailed knowledge of the computer operating system or gamma-ray spectroscopy. 3 refs., 5 figs., 4 tabs.

38600 **(GSI—87-57-Prepr.) Energetic particle emission from nuclear co-operation.** Knoll, J.; Shyam, R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Saha Inst. of Nuclear Physics, Calcutta (India)). Sep 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753376/JAW.

We discuss different reaction mechanisms for the production of energetic particles like pions and photons in heavy ion collisions. Arguments from the uncertainty relation do not allow for a simple interpretation in terms of a single nucleon nucleon scattering mechanism (NNSC), and ask for a co-operative multi-nucleon process. Therefore, we analyze in more detail the implication of the co-operative model presented earlier. It takes into account the co-operation of many nucleons during the pion production process, and the formation of composite fragments along with the produced probe. The model is analyzed in terms of moving source parameters. Calculations are performed with the model and compared with recently measured data on pion production at a beam energy of 25 MeV/nucl.

38601 **(IFUSP-P—668) Comparison of the gaussian approximation and Langevin's simulation in DIC (Deep inelastic collisions).** Pato, M.P.; Oliveira, E.C. de; Gomes, L.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Nov 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702271/JAW.

A numerical test is made of the Gaussian approximation to the Fokker-Planck equation for a Hamiltonian with two degrees of freedom and potentials and friction coefficients apropriate for the description of the deep inelastic collision of the system $^{90}A+^{232}Th$ at E sub (Lab)=279 Mev. The exact solution is constructed with the Langevin's simulation method. The failure of the Gaussian approximation is discussed and exhibit separately its sources from (i) diffusion coefficients, the linearization (ii) of the potentials and (iii) of the friction forces.

38602 **(IKDA—87/19) Three exit channels in the fission of $^{235}U(n,f)$.** Knitter, H.H.; Hambsch, F.J.; Budtz-Joergensen, C.; Theobold, J.P. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik; Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Jul 1987. 10p. Also published in Z. Naturforsch., A: Phys. Sci. (Aug 1987) Vol. 42(8) p. 786-790.

A formula for the fission fragment yield area in the coordinate system of the fragment total kinetic energy and of the fragment mass is presented. It was deduced along the lines of the multi-exit-channel model of fission elaborated by Brosa, Grossmann and Mueller. This formula was fitted to the fragment mass-, average total kinetic energy-, and variance distributions of the thermal neutron induced fission of ^{235}U. The obtained parameters are compared with the theoretical predictions. Further improvements of the fragment yield representation are discussed.

38603 **(INIS-BR—1018, pp 3) Percolation and nuclear fragmentation.** Chao, N.-C.; Chung, K.C. (Rio Grande do Norte Univ., Natal (Brazil). Dept. de Fisica Teorica e Experimental; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38604 **(INIS-mf—11219) 22nd Annual seminar on theoretical physics.** (Organization of Theoretical Physicists, Pretoria (South Africa); South African Inst. of Physics, Faure). 1987. 235p. (In English and Afrikaans). (CONF-8707166—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW.

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

The 22nd Annual Seminar on Theoretical Physics, held from 14-17 July on the Durban campus of the University of Natal, could be described as very successful from a number of different considerations. Seventeen papers were delivered on the Seminar which covered a wide spectrum of theoretical physics with emphasis on quantum chromodynamics and nuclear theory.

38605 **(INIS-mf—11219, pp 61-72) Studies of the EMC-effect.** Engelbrecht, C.A.; Marais, S.C. (Institute for Theoretical and Nuclear Physics, University of Stellenbosch, South Africa). 1987. (In Afrikaans). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

It is shown that the broad features of the EMC-effect are adequately explained by the folding model in which average binding energy of nucleons and the appropiately normalized contribution of pions are taken into account.

38606 **(INIS-mf—11219, pp 121-134) Chiral soliton model of the nucleon.** Gavin, E.J.O.; Tegen, R.; Zimak, P. (Institute of Theoretical Physics and Astrophysics, University of Cape Town, South Africa; Basel Univ. (Switzerland). Inst. fuer Physik). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

We give a description of the nucleon in terms of a smooth chiral confinement model. Three quarks in their ground state interact via a scalar-isoscalar mean field, and this quark core is surrounded by a pion cloud in accordance with chiral symmetry. Using the measured g/sub A/g/sub V/ of the neutron and the 'helicity argument' (only fields which contribute to the helicity of the nucleon contribute to g/sub A/g/sub V/) we find that the resulting confining potential passes through a maximum and approaches its asymptotic value from above.

38607 **(INIS-mf—11219, pp 147-155) When is a symmetry - or, exposing dynamical symmetries of the interacting boson model from a non-U(6) angle.** Geyer, H.B.; Hahne, F.J.W.; Scholtz, F.G. (Institute of Theoretical Nuclear Physics, University of Stellenbosch, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

We show that dynamical symmetries other than the known U(5), SU(3) or O(6) limits of the interacting boson model can be identified for some choices of the boson Hamiltonian parameters. The recently discussed SO(7) symmetry is hereby completely accommodated within a boson framework. Our analysis shows that this symmety is in fact characterised by a U(5) boson Hamiltonian accompanied by choices of transition operators which differ from the traditional choices. A new selection rule associated with SO(7) is also identified.

38608 (INIS-mf—11219, pp 157-183) **Origin of the exchange term in the interacting boson-fermion model.** De Kock, E.A.; Geyer, H.B. (Institute of Theoretical Nuclear Physics, University of Stellenbosch, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

Although a number of different types of boson-fermion interactions are possible in the interacting boson-fermion model, emperical results have shown that the exchange term is of cardinal importance. A recently constructed similarity transformation which reexpresses the Dyson boson images of the single-j shell fermion operators in terms of seniority bosons is used to show that the origin of the exchange term in spherical nuclei is intimately linked to the fermion quadrupole pairing interaction. The relative importance of the exchange and direct boson-fermion interactions is also discussed.

38609 (INIS-mf—11717) **System analytical studies on ground state properties of neutron-rich nuclides in the nuclear mass region A $\simeq$ 100. Application of the density functional method on a system of interacting bosons.** Toenhardt, M. (Technische Univ. Braunschweig (Germany, F.R.). Naturwissenschaftliche Fakultaet). 18 Jun 1987. 180p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753553/JAW.

In this thesis only nuclei with even proton and even neutron number have been studied. This constraint allows to use a for the description of excitation spectra very successful model, the interacting boson model (IBM) and to combine this with the density functional method. From the obtained Hamiltonian via an energy-density functional an effective potential is constructed which can be applied in the framework of the density-functional method in order to calculate ground state energies and densities. From the density distributions radii and values for the static deformation are determined. As further ground state property the separation energy for two neutrons is studied. (orig./HSI).

38610 (INIS-mf—11720) **Statement of all scission-point configurations according to trajectory calculations on the example of the neutron-induced particle-accompanied fission of $_{92}$236U.** Kraske, F. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik). Jan 1987. 147p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753556/JAW.

In the framework of the present thesis by comparison of the experimental measurement data obtained by means of the detector system DIOGENES with calculated trajectories possible scission-point configurations of the fissioning nucleus should be stated. Special interest was dedicated to the evaluation of the so-called particle-accompanied fission in which beside the two fission fragments yet a light particle is additionally emitted. The initial conditions of a fission searched for are obtained by means of trajectory calculations which yield for assumed starting values the physical quantities as result which are also experimental accessible like final energies of all three contributing particles and angle between the light particle and the light fragment. The calculations were performed both for spherical and for rotational-ellipsoidally deformed fragments. All calculations were performed including the Coulomb and nuclear interaction forces between the three contributing nuclei, the fission fragment, and the α particle. (orig./HSI).

38611 (INIS-mf—11722) **Proton-neutron degree of freedom in collective states of medium heavy nuclei.** Harter, H.J. (Koeln Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 11 Jul 1987. 180p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753558/JAW.

In this thesis the collective excitation forms of heavy nuclei are studied in the framework of the interacting boson model (IBM) which was developed by A. Arima and F. Iachello (1984). A description equivalent to the description of the dynamics of the surface is obtained in the IBM by the IBM-1 which not discriminates between protons and neutrons. The introduction of the proton-neutron degree of freedom occurs in the IBM-2 by the introduction of proton and neutron bosons. It is an essential aim of the present thesis to explain the apparent contradiction between the dominance of the proton-neutron interaction (IBM-2) and the phenomenological description power of the IBM-1 respectively to draw consequences from this. An essential mean for this is the introduction of the F spin which allows there application of the SU(2) group to the study of the Hamiltonian on its properties in connection with the proton-neutron exchange symmetry. The M1-transitions were used in order to study the purity of the F spin. In this connection the collective states of the nuclei ^{128}Xe and ^{168}Er could be consistently described in the energies, the B(E2) and the M1-transitions. (orig.HSI).

38612 (ITP—86-107) **Realization of Sp(4,R) model using the generating invariants technique.** Filippov, G.F. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702897/JAW.

The complete basis of the Sp(4,R) model for closed shells is constructed in the generating parameters space by means of the generating invariants techniques. Matrix elements of the multiparticle microscopic Hamiltonian are calculated between the basis functions of this model. 8 refs.

38613 (JINR—R-4-87-318) **Phenomenological description of nonadiabatic effects in deformed nuclei.** Mikhajlov, I.N.; Choriev, B.Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702171/JAW.

Possibilities of a separation of interaction of bands with $\Delta K=0$ and 2 from the Coriolis interaction ($\Delta K=1$) are discussed. The spectrum is investigated and reduced probabilities of E2-transitions is deformed nuclei are studied in the framework of the phenomenological model with taking into account of strong mixing of the g-, β- and γ-bands. That yields the quality differences of dependence of B(E2)-factors on $\Delta I=I/sub f/(I/sub f/+1)-I/sub i/(I/sub i/+1)$ in comparison with Mikhailov formula. 12 refs; 7 figs.; 3 tabs.

38614 (JINR-E—4-87-467) **Deuteron polarizability and S-wave πid scattering at energies below 1 keV.** Pupyshev, V.V.; Solovtsova, O.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702911/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The influence of deuteron polarizability on the S-wave π^+d-scattering in a low-energy limit is explored in the framework of the variable phase method. It is shown that the nonoscillating part of the S-wave cross section of π^+d-scattering has a deep and sharp minimum in the energy region $\sim$ 0.4 keV. 15 refs.; 3 figs.; 1 tab.

38615 **(JINR-R—4-87-382) Charge-exchange reactions.** Gareev, F.A.; Ershov, S.N.; Pyatov, N.I.; Fayans, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702932/JAW.

Submitted to the Organizing Comittee in Intern. symposium "Newest achievements in nuclear physics", Novosibirsk, 27 Jun - 1 Jul 1987.

Review of nuclear spin investigations in (p,n)-reactions at intermediate energies is given. Problems of describing polarization characteristics and reaction mechanisms are considered. Experimental information on nuclear structure of discrete spin states and resonances in continuum, and its microscopic analysis in theory of finite Fermi systems are discussed. 24 refs.; 5 figs.; 1 tab.

38616 **(LA-UR—88-1645) Improved calculation of the prompt fission neutron spectrum from the spontaneous fission of ^{253}Cf.** Madland, D.G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 23p. (CONF-880546—10). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010911/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

An improved calculation is presented for the prompt fission neutron spectrum N(E) from the spontaneous fission of ^{253}Cf. In this calculation the fission-spectrum model of Madland and Nix is used, but with several improvements leading to a physically more accurate representation of the spectrum. Specifically, the contributions to N(E) from the entire fission-fragment mass and charge distributions will be calculated instead of calculating on the basis of a seven-point approximation to the peaks of these distributions as has been done in the past. Therefore, values of the energy release in fission, fission-fragment kinetic energy, nuclear level density, and compound nucleus cross section for the inverse process will be considered on a point-by-point basis over the fragment yield distributions instead of considering averages of these quantities over the peaks of the distributions. Particular attention will be given to the energy-dependent compound nucleus cross sections and to the nuclear level density model. Other refinements to the calculation of N(E) will also be discussed. Results will be presented and compared with earlier calculations of the spectrum and with recent experimental measurements of the spectrum. 9 figs.

38617 **(LA-UR—88-1739) New developments in the GNASH nuclear theory code.** Arthur, E.D.; Young, P.G.; Kalbach, C. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-880546—11; CONF-880546—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010928/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

During the past year significant improvements have been made to the GNASH nuclear model code system that will be described in this paper. New features such as use of the Ignatyuk level-density model, inclusion of multistage preequilibrium reaction contributions, and approximations to Hauser-Feshbach models will be described and results illustrated. Of particular importance are models developed that describe gamma-ray emission competition relative to particle emission in full detail even for higher energy reaction processes. In addition to these model improvements, the code has been expanded to include up to 300–400 reaction paths in one calculation with options for simple, automatic problem setups. Also, a preliminary formulation of the Kalbach angular distribution phenomenology has been implemented that provides the capability for reasonably accurate calculations of double-differential cross sections and spectra. Calculational examples using the code options will be provided and comparisons to new higher energy neutron and proton measurements will be made. 12 refs., 5 figs.

38618 **(LBL—25024) Quasifragments: hot nuclei embedded in a nucleon vapor.** Fai, G.; Randrup, J. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 5p. (CONF-880260—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011959/JAW.

From 5. winter workshop on nuclear dynamics; Sun Valley, ID, USA (22 Feb 1988).

In nuclear collisions at intermediate energies, metastable complex nuclear fragments are produced abundantly during the primary stage of the reaction. Therefore, statistical models for nuclear disassembly must incorporate highly excited unstable fragment states in the phase space considered. In our previous treatments of nuclear disassembly, a particular unstable fragment state was included in the final phase space provided its (estimated) half-life exceeded the time characterizing the breakup process. A similar prescription was also employed in the recent exact microcanonical model of nuclear disassembly. Although such life-time arguments are intuitively appealing in the context of a disassembling source, their relevance is less clear for the treatment of static problems, e.g. excited infinite nuclear matter at subsaturation densities. It is therefore desirable to seek a better foundation for the description of high excited nuclear states, applicable to both static and dynamical scenarios. This is also practically important for the implementation of event generators developed to provide samples of multi-fragment final states of medium-energy nuclear collisions. Furthermore, microscopic dynamical simulations also encounter the problem when seeking to give a realistic description of the final nuclear fragments.

38619 **(LBL—25322) Role of compound nuclei in intermediate-energy heavy-ion reactions.** Moretto, L.G.; Wozniak, G.J. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 16p. (CONF-8806117—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011921/JAW.

From 3. international conference on nucleus nucleus collisions; Saint-Malo, France (6 Jun 1988).

Hot compound nuclei are frequently produced in intermediate-energy reactions through a variety of processes. Their decay is shown to be an important and at times dominant source of complex fragments, high energy-gamma rays, and even pions.

38620 **(SLAC-PUB—4551) Topics in nuclear chromodynamics: Color transparency and hadronization in the nucleus.** Brodsky, S.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1988. Contract AC03-76SF00515. 34p. (CONF-880331—6). NTIS, PC A03;3. Order Number DE88010679/JAW.

From 3. Lake Louise Winter Institute on quantum chromodynamics: theory and experiment; Lake Louise, Canada (6 Mar 1988).

The nucleus plays two complimentary roles in quantum chromodynamics: (1) A nuclear target can be used as a control medium or background field to modify or probe quark and gluon subprocesses. Some novel examples are color transparency, the predicted transparency of the nucleus to hadrons participating in high momentum transfer exclusive reactions, and formation zone phenomena, the absence of hard, collinear, target-induced radiation by a quark or gluon interacting in a high momentum transfer inclusive reaction if its energy is large compared to a scale proportional to the length of the target. (Soft radiation and elastic initial state interactions in the nucleus still occur.) Coalescence with co-moving spectators is discussed as a mechanism which can lead to increased open charm hadroproduction, but which also suppresses forward charmonium production (relative to lepton pairs) in heavy ion collisions. Also discussed are some novel features of nuclear diffractive amplitudes--high energy hadronic or electromagnetic reactions which leave the entire nucleus intact and give nonadditive contributions to the nuclear structure function at low {kappa←cur}/sub Bj/. (2) Conversely, the nucleus can be studied as a QCD structure. At short distances, nuclear wave functions and nuclear interactions necessarily involve hidden color, degrees of freedom orthogonal to the channels described by the usual nucleon or isobar degrees of freedom. At asymptotic momentum transfer, the deuteron form factor and distribution amplitude are rigorously calculable. One can also derive new types of testable scaling laws for exclusive nuclear amplitudes in terms of the reduced amplitude formalism.

38621 (UCRL—97948-Rev.1) Recent progress and current status of preequilibrium reaction theories and computer code ALICE. Blann, M. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 50p. (CONF-880342—1-Rev.1). NTIS, PC A03;3. Order Number DE88010617/JAW.

From International Centre for Physics workshop on applied nuclear theory and nuclear model calculations for nuclear technology application; Trieste, Italy (5 Mar 1988).

We review precompound decay theory with emphasis on implementation in the code ALICE. We discuss parameterizations of the hybrid model and sources of parameters. The importance of multiple preequilibrium decay is evaluated and illustrated. Applications to reactions with fission de-excitation are discussed, as well as methods of selecting parameters for actinide targets. 47 refs. 34 figs.

38622 Collapse of ring diagrams and nuclear-matter phase transitions. Jiang, M.F.; Heyer, J.; Yang, S.D.; Kuo, T.T.S. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review Letters;* **61**: No. 1, 38-41(4 Jul 1988).

We study a ring-diagram approach for nuclear matter where the particle-particle and hole-hole ring diagrams are calculated to all orders via a random-phase-approximation equation. This equation is found to have complex eigenvalues within a small temperature-density region, and our results suggest that this occurrence of complex eigenvalues may be a useful signal for nuclear-matter phase transitions. With a slightly modified Gogny interaction, our ring-diagram nuclear-matter calculations give rho$_0$ = 0.17 fm/sup -3/, E$_0$/A = -15.9 MeV, K = 127 MeV, and the liquid-gas critical temperature T/sub c/ = 7.6 MeV.

38623 Strong interacting probes for quark gluon plasma. Koch, P. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.; State Univ. of New York, Stony Brook (USA). Dept. of Physics). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **38**: No. 1/2, 269-272(Apr 1988). (CONF-8708166—). Contract AC02-76CH00016.

From 6. international conference on ultra-relativistic nucleus-nucleus collisions; Nordkirchen, F.R. Germany (24 Aug 1987).

We discuss hadronic signals for quark gluon plasma formation in relativistic nuclear collisions utilizing a non-equilibrium model for hadronisation of the plasma state. In particular, we find that several (non-)strange antibaryon to baryon ratios may serve as a signal for a baryon-rich plasma state. The $K^+\pi^+$ ratio turns out to be not a direct signal for plasma formation due to its dependence on details of the collision dynamics and hadronisation mechanism. Finally we argue that the eta' to eta ratio might be useful as a 'gluonometer' in measuring the gluonic content of the matter formed in the initial stage of the collision process.

38624 Dirac-Brueckner-Hartree-Fock approach in finite nuclei. Muether, H.; Machleidt, R.; Brockmann, R. (State Univ. of New York, Stony Brook (USA). Dept. of Physics; California Univ., Los Angeles (USA). Dept. of Physics; Los Alamos National Lab., NM (USA); Mainz Univ. (Germany, F.R.). Inst. fuer Physik). *Physics Letters [Section] B;* **202**: No. 4, 483-488(17 Mar 1988). Contract AC02-76ER13001.

The Dirac-Brueckner-Hartree-Fock (DBHF) approximation, which has been successful in describing the saturation properties of infinite nuclear matter, is extended to the calculation of finite nuclei. As an example the ground-state properties of ^{16}O are discussed. Inclusion of the relativistic effects yields a considerable increase for the radius of the charge distribution with essentially no change of the calculated binding energy. This improves the agreement with the experimental data considerably.

38625 Binding energies of the s-shell hypernuclei and the Λ well depth. Bodmer, A.R.; Usmani, Q.N. (Illinois Univ., Chicago (USA). Dept. of Physics; Argonne National Lab., IL (USA). Physics Div.; Illinois Univ., Urbana (USA). Dept. of Physics; Jamia Milia Islamia, New Delhi (India). Dept. of Physics). *Nuclear Physics [Section] A;* **477**: No. 4, 621-651(22 Feb 1988). Contract W-31-109-ENG-38.

Variational Monte Carlo calculations have been made for the s-shell hypernuclei; the well depth has been calculated variationally with the Fermi hypernetted chain method. A satisfactory description of all the relevant experimental Λ separation energies and also of the Λp scattering is obtained with reasonable phenomenological central two-pion exchange ΛN and ΛNN forces and strongly repulsive dispersive ΛNN forces. For the latter both spin-independent and spin-dependent forms were considered with the spin-dependent form preferred. The latter implies a smaller spin dependence of the ΛN force and contributes ≃ 13 to the 0^+-1^+ spin-flip splitting of the A=4 hypernuclei. For the NN forces central Mafliet-Tjon potentials were mostly used.

38626 Statistical properties of many-particle spectra VI. Fluctuation bounds on N—N T-noninvariance. French, J.B.; Kota, V.K.B.; Pandey, A.; Tomsovic, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Annals of Physics (New York);* **181**: No. 2, 235-260(1 Feb 1988).

The preceding paper (V) shows that fluctuation analysis applied to experimental data in a chaotic region of the nuclear spectrum, determines values or bounds for a parameter Λ, proportional to the mean-squared near-diagonal matrix element of a symmetry-breaking interaction. The immediate interest is with time-reversal invariance (TRI) for which bounds, not values, are found. We show here how this information can be reduced to a bound on α, the relative magnitude of the time-reversal noninvariant (TRNI) part of the nucleon-nucleon interaction. This is done in terms of the level and transition-strength densities, both given as explicit functions of the Hamiltonian parameters. It is shown that, just as univariate Gaussian densities are essential ingredients of the state density, so also bivariate Gaussians enter naturally into a theory for the transition strengths. Calculations made for a subset, namely /sup 167,169/Er, ^{233}Th, and ^{235}U, of the nuclei considered in (V), give αapprox. $<2 \times 10^{-3}$, a value which by some arguments is at the boundary of fundamental interest. It is found that $\Lambda D\alpha^2$ is roughly constant over the periodic table and varies only slowly with energy. This implies that, for α-bounds better by perhaps a factor 4 (or α-values), we need more small strengths in nuclei with small spacings such as ^{238}U (which presently yields no Λ-bound). The methods introduced here, which admit a number of simplifying approximations, are applicable to TRI studies via detailed-balance experiments proceeding through a compound nucleus, to other symmetries, and to a wide class of other problems. copyright 1988 Academic Press, Inc.

38627 Algebraic approach to medium energy proton scattering. Wenes, G.; Ginocchio, J.N. (Los Alamos National Lab., NM (USA)). *Journal of Physics F (London). Metal Physics (London);* **14 Suppl.**: S65-S70(1988). (CONF-8708101—).

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

The Glauber approximation for medium energy scattering of hadronic projectiles from nuclei is combined with the Interacting Boson Model to produce a transition matrix for elastic and inelastic scattering states. Examples of application of this formalism to proton scattering from /sup 154/Gd are presented.

38628 Proton-neutron interaction and nuclear collectivity. Casten, R.F. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Physics F (London). Metal Physics (London);* **14 Suppl.**: S71-S85(1988). (CONF-8708101—).

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

A review is given of several aspects, and empirical consequences, of the p-n interaction as it relates to the structure, phase transitions and collectivity of medium and heavy nuclei. The Nsub(p)Nsub(n) scheme is reviewed as background material while the emphasis centers on a discussion of a related quantity, the P factor, and on the relationship of the integrated strength of the p-n interaction to the empirically observed saturation of B(E2) values in the mid-shell regions of deformed nuclei.

38629 **Algebraic and supersymmetric treatment of odd-odd nuclei.** Paar, V.; Brant, S.; Vretenar, D.; Sunko, D.K.; Balantekin, A.B.; Huebsch, T. (Zagreb Univ. (Yugoslavia). Zavod za Theorijsku Fiziku; Oak Ridge National Lab., TN (USA); Maryland Univ., College Park (USA)). pp 179-188 of Symmetries and semiclassical features of nuclear dynamics. Invited lectures. Raduta, A.A. (Institutul Central de Fizica, Bucharest (Romania). Dept. of Theoretical Physics) (ed.). Berlin, Germany, F.R.; Springer (1987). (CONF-8609219—).

From Brasov international summer school: symmetrics and semiclassical features of nuclear dynamics; Poiana Brasov, Romania (1 Sep 1986).

Four related algebraic approaches to odd-odd nuclei are described. Results of recent calculations are given, and possible extensions and current problems are discussed.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 36786, 36984, 37326, 37448, 37541, 37932, 38278, 38660

38630 **(CONF-880546—1) High-resolution neutron transmission measurements on ^{235}U, ^{239}Pu, and ^{233}U.** Harvey, J.A.; Hill, N.W.; Perey, F.G.; Tweed, G.L.; Leal, L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03;3. Order Number DE88010443/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

High-resolution transmission measurements have been made on three sample thicknesses of both ^{235}U and ^{239}Pu at liquid nitrogen temperature and also on three of ^{233}U at room temperature using neutrons from the water-moderated ORELA target. The data on ^{235}U and ^{239}Pu from 1 to 10,000 eV were obtained using ^{6}Li glass scintillation detectors at 17.909-and 80.394-m flight paths. The ^{233}U data from 1 to 100 keV were obtained using a new NE 110 proton-recoil scintillation detector at a 210.558-m flight path.

38631 **(CONF-880546—19) Neutron sources: present practice and future potential.** Cierjacks, S.; Smith, A.B. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012009/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The present capability and future potential of accelerator-based monoenergetic and white neutron sources are outlined in the context of fundamental and applied neutron-nuclear research. The neutron energy range extends from thermal to 500+ MeV, and the time domain from steady-state to pico-second pulsed sources. Accelerator technology is summarized, including the production of intense light-ion, heavy-ion and electron beams. Target capabilities are discussed with attention to neutron-production efficiency and power-handling capabilities. The status of underlying neutron-producing reactions is summarized. The present and future use of neutron sources in: (i) fundamental neutron-nuclear research, (ii) nuclear-data acquisition, (iii) materials-damage studies, (iv) engineering test, and (v) biomedical applications are discussed. Emphasis is given to current status, near-term advances well within current technology, and to long-range projections.

38632 (GSI—87-11, pp A4.1-A4.3) **Nuclear interaction of heavy ions.** Schimmerling, W. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

38633 (GSI—87-11, pp A5.1-A5.4) **Multiple scattering of fast heavy ion beams for biomedical uses.** Phillips, M.H.; Tobias, C.A.; Ludewigt, B.; Wong, M.; Schimmerling, W.; Frankel, K.A.; Fabrikant, J.I. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

38634 (GSI—87-11, pp A6.1-A6.3) **Semi-empirical calculations of stopping power, effective charge and ranges of heavy ions (1-400 MeV/u) in water.** Kiefer, J. (Giessen Univ. (Germany, F.R.). Strahlenzentrum). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

38635 (GSI—87-11, pp A7.1-A7.2) **Calculation of energy deposition in microscopical sites by heavy ions.** Kiefer, J.; Straaten, H. (Giessen Univ. (Germany, F.R.). Strahlenzentrum). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

38636 (GSI—87-11, pp A8.1-A8.2) **Energy- and angular-distribution of heavy-ion induced δ-electrons.** Schmidt, S.; Schmidt-Boecking, H.; Kelbch, C.; Kraft, G. (Frankfurt Univ. (Germany, F.R.)). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

38637 **(JINR-R—3-87-220) New possibilities in the study on magnetic films using of ultracold neutrons.** Taran, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702929/JAW.

Submitted to the International Conference on Neutron Physics (Kiev, 21-25 Sep 1987).

Theoretical consideration is given to the transmission of ultracold (UCN) neutrons through ferromagnetic films. A possibility is demonstrated to derive new information about spin dependence of the UCN-magnetic film interaction from experiments on UCN multitransmission. Two versions of the apparatus on the basis of UCN traps are proposed to measure transmissions thorugh one and the same film. the process of UCN flow from one trap into other through a mirror neutron guide is analysed. There is shown a possibility of storing a considerable part of the initial UCN flux. A combination of the UCN flow and storage modes in one setup is considered to show good prospects for the future study on thin magnetic films. 8 refs.; 4 figs.

38638 **(LA—11188-PR) Radiation transport: Progress report, April 1, 1987-June 30, 1987.** O'Dell, R.D.; Byers, H.M. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 73p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88010474/JAW.

Progress in radiation transport research and development by Los Alamos National Laboratory's Group X-6 during the third quarter of FY87 is reported. Included are unclassified tasks in the areas of Monte Carlo Radiation Transport, Cross Sections and Physics, and Deterministic Radiation Transport. 44 refs., 10 figs., 9 tabs.

38639 **(LA—11249-PR) Radiation transport: Progress report, July 1, 1987-September 30, 1987.** O'Dell, R.D.; Nagy, A. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010481/JAW.

Research and development progress in radiation transport for the Los Alamos National Laboratory's Group S-6 for the fourth quarter of FY 87 is reported. Included are unclassified tasks in the areas of Deterministic Radiation Transport, Monte Carlo Radiation Transport, and Cross Sections and Physics. 23 refs., 9 figs.

38640 (LA-UR—88-1640) New neutron physics using spallation sources. Bowman, C.D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 28p. (CONF-880546—7). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010914/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The extraordinary neutron intensities available from the new spallation pulsed neutron sources open up exciting opportunities for basic and applied research in neutron nuclear physics. The energy range of neutron research which is being explored with these sources extends from thermal energies to almost 800 MeV. The emphasis here is on prospective experiments below 100 keV neutron energy using the intense neutron bursts produced by the Proton Storage Ring (PSR) at Los Alamos. 30 refs., 10 figs.

38641 (LA-UR—88-1663) Materials science at an Advanced Hadron Facility. Pynn, R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 09p. (CONF-880263—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010945/JAW.

From Accelerator design workshop; Los Alamos, NM, USA (22 Feb 1988).

The uses of neutron scattering as a probe for condensed matter phenomena are described briefly and some arguments are given to justify the community's desire for more powerful neutron sources. Appropriate design parameters for a neutron source at an Advanced Hadron Facility are presented, and such a source is compared with other existing and planned spallation neutron sources. 5 refs.

38642 (ORNL/RSIC—50) Discrete angle biasing in Monte Carlo radiation transport. Cramer, S.N. (Oak Ridge National Lab., TN (USA). Radiation Shielding Information Center). May 1988. Contract AC05-84OR21400. 91p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010736/JAW.

An angular biasing procedure is presented for use in Monte Carlo radiation transport with discretized scattering angle data. As in more general studies, the method is shown to reduce statistical weight fluctuations when it is combined with the exponential transformation. This discrete data application has a simple analytic form which is problem independent. The results from a sample problem illustrate the variance reduction and efficiency characteristics of the combined biasing procedures, and a large neutron and gamma ray integral experiment is also calculated. A proposal is given for the possible code generation of the biasing parameter p and the preferential direction {ovr{Omega}}$_0$ used in the combined biasing schemes.

38643 (SAND—87-2869C) MEASTRI:. Brice, D.K. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-880512—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009469/JAW.

From 8. international conference on plasma surface interactions in controlled fusion devices; Julich, F.R. Germany (2 May 1988).

We report the development of a hybrid analytic/Monte Carlo code for evaluating particle transport in solids. Atomic concentrations in the near surface implanted region of a target material {N{sub k}(x,t)}, are propagated by the code in time through the previously described method of equivalent atomic stopping (MEAS). Implantation source profiles {P{sub k}(x,t)} are obtained for the initial target composition with the TRIM code (TRI), and propagated in time along with the {N{sub K}(x,t)} by MEAS. TRIM is also invoked periodically to provide updated profiles {P{sub k}(x,t)}, since the MEAS procedure includes only first order corrections to the {P{sub k}} due to the evolution of the {N{sub k}}. The code provides for simultaneous implantation of several different atomic species and includes the local mixing model (LMM) for describing buildup to saturation and isotope exchange for implantation of hydrogen (and/or other species). 12 refs., 1 fig.

38644 (UCID—21276) Gamma ray emission from spheres pulsed with D-T neutrons: Results of May 1987 experiments at RTNS-1. Goldberg, E.; Hansen, L.F.; Howerton, R.J.; Komoto, T.T.; Pohl, B.A. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 44p. NTIS, PC A03;3. Order Number DE88011357/JAW.

Subsequent to the analysis of the June 1986 series of experiments at RTNS-1, we thought it sensible to repeat some of the experiments with greater care given to the high energy portions of the effluent gamma ray spectra. In addition, some new materials were recommended for study, such as silicon. And since among our earlier experiments we observed data which was not highly reproducible, repeated runs would provide a quantitative assessment of the precision of the experiments. Accordingly, we followed the procedure outlined in UCID-20884. First, we calibrated the NE-213 detector with standard gamma ray sources and checked for linearity of pulse height with energy deposited by electrons. We then conducted experiments at RTNS-1, using spherical configurations of C, Si, Al, H_2O, N_2,Ti, Fe, and C_2F_4. The H_2O was contained in a modified glass flask, while the liquid nitrogen was held in a double-walled steel dewar. 25 refs., 17 figs., 9 tabs.

38645 Propagation of a picosecond-duration, relativistic electron beam through hydrogen at atmospheric pressures. Fisher, A.S.; Pantell, R.H.; Feinstein, J.; Deloney, T.L.; Reid, M.B. (Department of Electrical Engineering, Stanford University, Stanford, California 94305). *Journal of Applied Physics;* **64**: No. 2, 575-580(15 Jul 1988).

An experiment demonstrating the propagation of a 42-MeV electron beam from an rf linear accelerator through 1 m of H_2 at pressures from 10^{-3} to 1.25 atm is reported. Measurements were made of the transmitted current and the beam's radius, transverse position, and angular divergence along the path. The beam current was fully transmitted at all pressures, without the often detrimental plasma interactions (space-charge neutralization, magnetic neutralization, and various plasma instabilities) seen in previous studies. The observed beam expansion was consistent with calculations of multiple scattering. The propagation can be attributed to the 4-ps duration of the accelerator's electron bunches. This time is three to four orders of magnitude shorter than that used in the earlier work and is shorter than the growth times for the beam-plasma interactions. Such a beam should prove suitable for a gas-loaded free-electron laser.

6550 Medical Physics

REFER ALSO TO CITATION(S) 37574, 37579, 37580, 37581, 37882, 37918, 37993, 39040

38646 (ENEA-RT-COMB—86-4) Post Chernobyl-1. Measurements of radionuclides at Saluggia (Vercelli). Giacomelli, R.; Spezzano, P.; Nocente, M.; Dattrino, A.; Massironi, L.; Ornaghi, A.; Silvestri, N.; Porsio, L.; Olivetti, R. (ENEA, Saluggia (Italy). Centro Ricerche Energia; USL 45, Vercelli (Italy)). (ENEA, Rome (Italy)). 1987. 17p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702842/JAW.

After a description of the sampling and measurement methods, the values of air concentration for ^{103}Ru, ^{131}I, ^{132}Te, ^{134}Cs, ^{137}Cs and ^{140}Ba measured in Sluggia (Italy) from April 29 to May 31, 1986 are here reported. In two filtres ^{89}Sr, ^{90}Sr, ^{234}U, ^{239}Pu and $^{239-240}$Pu were also measured.

38647 (ENEA-RT-COMB—86-6) Post Chernobyl-2. Measurement of radionuclides in the fallout at Saluggia (Vercelli). Giacomelli, R.; Spezzano, P.; Nocente, M.; Dattrino, A.; Massironi, L.; Ornaghi, A.; Silvestri, N.; Porsio, L.; Olivetti, R. (ENEA, Saluggia (Italy). Centro Ricerche Energia; USL 45, Vercelli (Italy)). (ENEA, Rome (Italy)). 1987. 16p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702843/JAW.

After a description of the sampling and measurement methods, the values of fall-out concentration for gamma emitters measured in Saluggia (Italy) from May 1 to July 18, 1986 are here re-

ported. In some sample ^{89}Sr, ^{90}Sr, ^{234}U, ^{235}U, ^{238}Pu and $^{239-240}Pu$ were also measured.

38648 **(ENEA-RT-COMB—87-5) Post Chernobyl-4. Exposure rate measurements at Saluggia (Vercelli).** Anon. (ENEA, Rome (Italy)). 1987. 11p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702844/JAW.

After a description of the measurement methods, the values of gamma exposure rate measured in Saluggia (Italy) from May 5 to May 30, 1986 are here reported.

38649 **(ENEA-RT-COMB—87-9) Post Chernobyl-6. Measurement of radiation in vegetables at Crescentino and S. Germano Vercellese.** Giacomelli, R.; Spezzano, P.; Nocente, M.; Bortoluzzi, S.; Dattrino, A.; Massironi, L.; Ornaghi, A.; Silvestri, N.; Porzio, L.; Olivetti, R. (ENEA, Saluggia (Italy). Centro Ricerche Energia; USL 45, Vercelli (Italy)). (ENEA, Rome (Italy)). 1987. 28p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702845/JAW.

After a description of the sampling and measurement methods, the values of vegetables concentration for gamma emitters measured in Crescentino and San Germano Vercellese from May 1 to September 24, 1986 are here reported. In some sample ^{89}Sr and ^{90}Sr were also measured.

38650 **(ENEA-RT-COMB—87-10) Post Chernobyl-5. Radiometric and radiotoxicological checks.** Carbonaro, V.; Cigna, A.A.; Cortissone, C.; Giacomelli, R.; Pirastru, E.; Spezzano, P. (ENEA, Saluggia (Italy). Centro Ricerche Energia). (ENEA, Rome (Italy)). 1987. 12p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702846/JAW.

This paper gives the results of individual monitoring carried out on population after Chernobyl accident. After a brief description of measurement methods as well as instrumentation features, the results of I-131 contamination in thyroid and of beta-gamma emitters on people's skin and clothing are reported. From the information available it appears that people coming out from Kiev (U.S.S.R.) showed the higher contamination.

38651 (GSI—87-11, pp A1.1-A1.5) **Review of radial dose profiles for heavy ions.** Varma, M.N.; Baum, J.W. (Brookhaven National Lab., Upton, NY (USA). Safety and Environmental Protection Div.). Jul 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753546/JAW. (CONF-870779—).

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

38652 **(INFO—0134) Cooperative development of nuclear safety regulations, guides and standards based on NUSS.** Pachner, J.; Boyd, F.C.; Yaremy, E.M. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Oct 1984. 19p. (CONF-841018—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701918/JAW.

From International symposium on the implementation of the IAEA codes of practice and safety guides for nuclear power plants; Vienna, Austria (29 Oct 1984).

In 1983, the Atomic Energy Control Board and Atomic Energy of Canada Limited conducted a study of a possible joint program involving Canada, a nuclear power plant importing Member State and the IAEA for the development of the national nuclear safety regulations and guides based on NUSS documents. During the study, a work plan with manpower estimates for the development of design was prepared as an investigatory exercise. The work plan suggests that a successful NUSS implementation in developing Member States will require availability of significant resources at the start of the program. The study showed that such a joint program could provide an effective mechanism for transfer of nuclear safety know-how to the developing Member States through NUSS implementation.

38653 (INIS-mf—11153, pp 43-50) **5. Radiation protection.** Konecny, J. 1987. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780081/JAW.

In Nuclear power. CAEC lecturers' manual.

The problems, targets and principles of radiation protection are surveyed. The most important concepts, quantities and units used in radiation protection are listed. Attention is paid to biological radiation effects, external and internal irradiation, radiaton sources and dosimetric systems at nuclear power plants. Discussed are the basic methods of radiation protection based on the factor of time, distance from the radiation source and shielding, and the questions of the limit dose system which should comprise the justification of the respective human activity, optimization of radiation protection and annual dose equivalent limits. The limits are outlined of reducing exposure with respect to costs which society is willing to expend for the given purpose. (Z.M.).

38654 **(PNL—6500-Pt.5) Pacific Northwest Laboratory annual report for 1987 to the Assistant Secretary for Environment, Safety, and Health: Part 5: Environment, safety, health, and quality assurance.** Faust, L.G.; Steelman, B.L.; Selby, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 63p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011704/JAW.

Part 5 of the 1987 Annual Report to the US Department of Energy's Assistant Secretary for Environment, Safety, and Health presents Pacific Northwest Laboratory's progress on work performed for the Office of Nuclear Safety, the Office of Environmental Guidance and Compliance, the Office of Environmental Audit, and the Office of National Environmental Policy Act Project Assistance. For each project, as identified by the Field Work Proposal, articles describe progress made during fiscal year 1987. Authors of these articles represent a broad spectrum of capabilities derived from five of the seven technical centers of the Laboratory, reflecting the interdisciplinary nature of the work.

38655 **Fast MLE for SPECT using an intermediate polar representation and a stopping criterion.** Herbert, T.; Leahy, R.; Singh, M. (Signal and Image Processing Institute, Dept. of Electrical Engineering-Systems, Univ. of Southern California, Los Angeles, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 615-619(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The maximum likelihood (ML) approach to SPECT has received considerable interest since the application of the EM algorithm to emission tomography. In addition to the appealing asymptotic properties of ML solutions, the EM algorithm has guaranteed convergence to a positive solution. In practice, several drawbacks to a ML approach are encountered: 1) the computational demands are quite large, especially in comparison to non-iterative techniques; 2) reconstructions tend to take on an increasingly, non-smooth quality as the ML solution is approached, so the algorithm is usually terminated long before convergence. The authors address these problems on two levels. First, the authors perform the actual source estimation on a rectangular grid, but the authors use a polar pixel representation of the source during forward/back projection operations to reduce the computational requirements. Secondly, they use a chi-squared test to statistically determine a suitable cut-off point for the iterative process.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 36723, 36731, 36739, 36746, 36803, 36918, 36930, 36936, 36951, 37173, 37331, 37393, 37541, 37580, 37627, 38290, 38303, 38641, 38767

38656 **(AD-A—190655/1/XAB) Fluids, gels and glasses under extreme conditions of pressure and temperature. Final technical report, 1 October 1986-30 September 1987.** Jonas, J. (Illinois Univ., Urbana (USA). Dept. of Chemistry). 22 Jan 1988. 18p. NTIS, PC A03/MF A01.

A multi-nuclear, high-resolution, high-field NMR spectrometer system equipped with wide-bore (89 mm) 7.05-Tesla supercon-

ducting magnet, and accessories for high-resolution solid-state work and an NMR data station were funded under this instrumentation grant. The basic system, a General Electric GN-300, was installed in September, 1986. The necessary accessories for high resolution NMR work on solids were installed. The new Nicolet 1280 NMR data system, delivered in October 1986, is currently being used to control a recently built specialized NMR spectrometer using a wide-bore 4.2-Tesla superconducting magnet made by Oxford Instruments.

38657 (CONF-870155—) Dynamic interactions of energetic probes with condensed matter: Proceedings. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 557p. NTIS, PC A23/MF A01;3. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Individual papers have been indexed separately.(WRF)

38658 (CONF-880614—3) Temperature dependence and the moving species during ion mixing. Xia, W.; Fernandes, M.; Hewett, C.A.; Lau, S.S.; Poker, D.B.; Biersack,J.P. (California Univ., San Diego, La Jolla (USA). Dept. of Electrical and Computer Engineering; Oak Ridge National Lab., TN (USA); Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010459/JAW.

From 7. international conference on ion implantation technology; Kyoto, Japan (7 Jun 1988).

In this paper, the authors review the experimental observations of the temperature dependence and the moving species in ion mixing, emphasizing the metal-semiconductor systems. Ion mixing is the combined effect of two components. One component is temperature independent and is primarily due to events in the prompt regime, the other component is temperature dependent and has the characteristics of the associated thermal reactions. The moving species during ion mixing are influenced by collisional effects, either due to secondary recoils, or due to local hot spots, or both. The secondary recoil concept is consistent with experimental observations that the motion of the lighter element in a bilayer sample is enhanced. There is ample evidence that while the a thermal regime is caused by particle-solid interactions, thermodynamical forces are important in deciding the magnitude of mixing. In the thermally activated regime, the ion induced reaction product should be influenced by the heats of formation of various compounds. We also indicate areas where satisfactory explanations are not available at present.

38659 (CONF-8804117—3) Computer simulation of elastic properties of grain boundary materials. Wolf, D.; Lutsko, J.F. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011965/JAW.

From Adhesion in solids; Reno, NV, USA (5 Apr 1988).

Lattice statics and lattice dynamics computer simulation methods are applied to investigate the elastic properties of grain boundaries in fcc metals. The elastic constants in the GB region are found to differ significantly from their bulk ideal-crystal values. Due to the broken symmetry in the GB region a pronounced anisotropy of the elastic properties is observed. Whereas Young's moduli are found to increase in the GB region, the shear modulus and Poisson's ratios generally decrease. The magnitude of these effects is shown to depend sensitively on the GB structure.

38660 (CONF-8804141—2) Energy deposition by partially stripped ions. Crawford, O.H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. (CONF-8804141—2; CONF-8804141—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011409/JAW.

From 11. Werner Brandt workshop on penetration phenomena of charged particles in water; Oak Ridge, TN, USA (14 Apr 1988).

The report discusses both the collisional and the restricted collisional energy deposition rates of partially stripped ions. The results may be useful in connection with radiation effects that depend on the amount of energy deposited close to the surface of a target. 6 refs., 4 figs.

38661 (CONF-8805110—1) Challenge equality problems in lattice theory. McCune, W. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010094/JAW.

From 9. international conference on automated deduction (CAD-9); Argonne, IL, USA (23 May 1988).

This note contains five problems which should be useful for experimentation with equality-oriented automated theorem-proving programs. The problems are formally stated and proved in first-order predicate calculus with equality. The problems are taken from the often-overlooked paper "Semi-automated mathematics" by Guard et al. All of the theorems concern the existence and uniqueness of complements in modular lattices with 0 and 1.

38662 (CONF-8805140—2) Dynamics of high-energy nucleus-nucleus collisions. Wong, C.Y.; Lu, Z.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011387/JAW.

From International conference on medium- and high-energy nuclear physics; Taipei, Taiwan (23 May 1988).

The authors use a Glauber multiple-collision model to examine the dynamics of nucleus-nucleus collisions. The model introduces a stopping law, which describes how a baryon loses energy in a baryon-baryon collision, and a particle production law, which is based on the baryon energy loss. The model gives results on the longitudinal energy loss which compare well with the recent WA80 experimental data for ^{16}O on various targets at 60 and 200 GeV per nucleon. The stopping law that is needed to fit the experimental zero-degree spectra reveals that the degree of stopping in these high-energy nuclear collisions is high.

38663 (DOE/ER/13429—3) Supersonic bare metal cluster beams: Technical progress report, April 15, 1987-April 15, 1988. Smalley, R.E. (Rice Univ., Houston, TX (USA). Dept. of Chemistry). 1988. Contract FG05-85ER13429. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88010244/JAW.

The emphasis in our bare metal cluster research over the past year has continued to focus on development and applications of the two key new techniques: FT-ICR and UPS. FT-ICR is a technique for the study of chemisorption phenomena on bare metal cluster ions. UPS (ultraviolet photoelectron spectroscopy) is used to study size-selected negative cluster ions. Both are described in this paper. (LSP)

38664 (DOE/ER/45144—2) Research in the theory of condensed matter and elementary particles: Final report, September 1, 1984-November 30, 1987. Friedan, D.; Kadanoff, L.; Nambu, Y.; Shenker, S. (Chicago Univ., IL (USA)). Apr 1988. Contract FG02-84ER45144. 53p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010180/JAW.

Progress is reported in the field of condensed matter physics in the area of two-dimensional critical phenomena, specifically results allowing complete classification of all possible two-dimensional critical phenomena in a certain domain. In the field of high energy physics, progress is reported in string and conformal field theory, and supersymmetry.

38665 (DOE/ER/45211—2) Non-transferable van der Waals potentials: Insulators at high pressure. Maggs, A.C.; Ashcroft, N.W. (Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics). Jan 1987. Contract FG02-85ER45211. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009162/JAW.

For a simple model whose cohesion is dominated by dispersion forces we show that the expansion of the energy in terms of multi-center interactions is ill conditioned at a low density. This density is physically realizable for systems with highly polarizable atoms, and in these circumstances an alternative expression for the internal energy is required. For polarizable systems the requisite

densities are readily achievable with the use of modern high pressure capabilities, and have consequences for the interpretation of equation of state data in terms of potential energy functions. 13 refs., 3 figs.

38666 **(DOE/ER/45334—1) Electronic states in tunneling semiconductor superlattices: Technical progress report for the period September 15, 1987-September 14, 1988.** Ulloa, S.E. (Ohio Univ., Athens (USA). Dept. of Physics and Astronomy). 15 May 1988. Contract FG02-87ER45334. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011571/JAW.

This research project funded by DOE has concentrated in the systematic study of the effects of a gate voltage on the electronic structure of a tunneling superlattice system. The effects of strong magnetic fields and other various parameters on energy levels of tunneling superlattices have been investigated.(LSP)

38667 **(INFN/TC—88-3) Thin films preparation by the electrospray method in heavy ion induced desorption experiments.** Riggi, F.; Spina, R. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702279/JAW.

Some details of the experimental procedure used to prepare thin films of organic compounds by the electrospray method are reported.

38668 **(INFN/TC—88-5) Angular dependence on the sputtering yield measured by low energy pixe analysis.** Torrisi, L. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702280/JAW.

Sputtering yield of Au thin films by 80 KeV argon ions bombardament has been measured "in situ" using the PIXE analysis with low energy proton beams (100 KeV). Typically a rising yield is seen, as the angle between surface normal and incoming beam, θ, increases from zero, according the sec θ law. The measured angular dependence on the sputtering yield and the used analysis method have been discussed in detail.

38669 (INIS-BR—1018, pp 13) **Copper interaction with tri (hydroximethyl) amino methane.** Silva, L.A.; Colombo, M.F.; Nascimento, O.R.; Castellano, E.E.; Tabak, M. (Alagoas Univ., Maceio (Brazil). Dept. de Fisica; Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38670 (INIS-BR—1018, pp 36) **Determination of tetragonal distortion in Na/sub 3-x/]Fe(CN)$_5$L/sub x/]nH$_2$O complexes by Moessbauer spectroscopy.** Araujo, J.H. de; Araujo, M.A.B. de; Moreira, I.S.; Coelho, A.L. (Ceara Univ., Fortaleza (Brazil). Dept. de Fisica; Ceara Univ., Fortaleza (Brazil). Dept. de Quimica Organica e Inorganica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38671 (INIS-BR—1018, pp 36) **Debye Waller factor of surface atoms.** Mauriz, P.W.; Albuquerque, E.L. de. (Rio Grande do Norte Univ., Natal (Brazil). Dept. de Fisica Teorica e Experimental). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38672 (INIS-BR—1018, pp 40) **Uni-dimensional magnetic superlattices - Thermodynamic properties.** Borges, J.; Lyra, M.L. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38673 (INIS-BR—1018, pp 41) **Energy spectra in superlattices: use of the transfer matrix technique.** Costa, W.B. da; Albuquerque, E.L. de. (Rio Grande do Norte Univ., Natal (Brazil). Dept. de Fisica Teorica e Experimental). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38674 (INIS-BR—1018, pp 41) **Polaritons in NIPI type superlattices.** Albuquerque, E.L. de; Auto, M.M.; Farias, G.A. (Rio Grande do Norte Univ., Natal (Brazil). Dept. de Fisica; Ceara Univ., Fortaleza (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38675 (INIS-BR—1075, pp 8) **Mass amplitudes and critical exponuents in the Ising model.** Alcaraz, F.C.; Brezin, E. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38676 (INIS-BR—1075, pp 8) **Finite lattice convolution.** Oliveira, P.M. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38677 (INIS-BR—1075, pp 8) **Non-universality in Ising models with defects.** Guimaraes, L.G.; Felicio, J.R.D. de. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38678 (INIS-BR—1075, pp 9) **Monte Carlo method applied to the SOS model-Roughness transition.** Silva, M.A.A. da; Mokross, B.J. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38679 (INIS-BR—1075, pp 10) **Dynamical susceptibility for impurity of intermediate valence.** Foglio, M.E.; Schlottmann, P. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38680 (INIS-BR—1075, pp 19) **On the equivalence of dilute antiferromagnets and ferromagnets in random external fields.** Perez, J.F.; Pontin, L.F.; Baela Segundo, J.A. 1985. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38681 (INIS-BR—1075, pp 13) **Energy spectra in resonant system.** Carvalho, R.E. de; Almeida, A.M.O. de. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38682 (INIS-BR—1075, pp 14) **Effects of discrete chain in one dimensional antiferromagnet.** Talim, S.L.; Pires, A.S.T. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38683 (INIS-BR—1075, pp 14) **Electronic structure of disordered one dimensional crystals.** Nunez, E.L. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38684 (INIS-BR—1075, pp 14) **Correction of short range in quasi-onedimensional ferroelectrics.** Carvalho, A.V. de; Pires, A.S.T. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38685 (INIS-BR—1075, pp 14) **Dynamic of solitons and magnons in TMMC onedimensional antiferromagnet.** Costa, B.V. da; Pires, A.S.T. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38686 (INIS-BR—1075, pp 15) **Soliton density in TMMC in the Ising Limit.** Gouvea, M.E. de; Pires, A.S.T. 1985. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38687 (INIS-BR—1075, pp 16) **Non perturbative renormalization of massive Thirring model in non renormalizable region.** Santos, A.L.; Marino, E.C. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38688 (INIS-BR—1075, pp 21) **Phase diagram of Ising model with competitive interactions in the Bethe lattice.** Silva, C.R. da; Coutinho, S. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38689 (INIS-BR—1075, pp 22) **Spin 1 model for ternary alloy systems.** Osorio, R. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38690 (INIS-BR—1075, pp 22) **Phase transition in a mixed diluted spin system.** Siqueira, A.F.; Fittipaldi, I.P. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38691 (INIS-BR—1075, pp 22) **Anisotropic Heisenberg surface on a Ising ferromagnetic volume.** Costa, U.M.S.; Mariz, A.M.; Tsallis, C. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38692 (INIS-BR—1075, pp 23) **Spin glass phase of Fe_2TiO_5.** Cruz, J.M.R.; Morais, P.C.; Skeff Neto, K. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38693 (INIS-BR—1075, pp 23) **Correlated percolation and diluted magnetism.** Branco, N.S.; Queiroz, S.L.A. de; Santos, R.R. dos. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38694 (INIS-BR—1075, pp 23) **Diluted antiferromagnets in uniform field and ferromagnets in random field.** Queiroz, S.L.A. de; Santos, R.R. dos. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38695 (INIS-BR—1075, pp 24) **Competitive random anisotropy.** Santos, R.M.Z. dos; Mariz, A.M.; Santos, R.R. dos. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38696 (INIS-mf—11219, pp 205-222) **Hubbarb model for the BCC lattice.** Villet, C.M. (Rand Afrikaans Univ., Johannesburg (South Africa). Dept. of Physics). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

A variational method is used to find approximative solutions of the Hubbard model for the ground state of the bcc lattice in the weak and strong coupling limits. The neutral case (a half-filled band) is found to be antiferromagnetic for all values of the coupling constant. However, for other choices of the band-filling second order phase transitions between different magnetic structures are found if the coupling constant is varied.

38697 (INIS-mf—11700) **Localization and diffusion of positive muons in electron irradiated niobium and tantalum.** Doering, K.P. (Stuttgart Univ. (Germany, F.R.). Fakultaet 12 - Physik). 22 Jun 1987. 241p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753551/JAW.

For monocrystals of Ta and very pure Nb the transversal spin-depolarization (or relaxation) of positive muons is measured. It is found that for both metals by irradiation with 3 MeV electrons two further sorts of defects are created which capture the muons. For the quantitative analysis a model is developed. (orig./BHO).

38698 (JINR-E—14-87-180) **Correction for thermal diffuse scattering in the time of flight neutron diffraction.** Popa, N.C. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702916/JAW.

Submitted to the journal Phys. Status Solidi.

Using traditional approximations, the correction for thermal diffuse scattering in the neutron time-of-flight diffraction on monocrystals is calculated. This scattering measured by the time-of-flight

method from that measured by the angular dispersive diffraction method and this can be explained with the aid of the scattering surface. In time-of-flight the scattering surface has different geometries in three regions of the ratio between the sound velocity in crystal and the neutron velocity; in the angular dispersive method are only two such regions. The difference between the two methods disappears if the flight path after sample is very small comparatively with the total flight path. 13 refs.; 6 figs.

38699 **(JINR-E—14-87-662) Texture investigation by neutron diffraction.** Feldmann, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702917/JAW.

Submitted to the 8. Intern. Conf. on Textures of Materials ICOTOM 8, Santa Fe, USA, 20 - 25 Sep, 1987.

In the conventional angle dispersive neutron diffraction a monochromatic neutron beam is used. The pole figures under investigation have to be scanned one after another. The commonly applied angle dispersive method is limited to the consideration of Bragg reflection being isolated in the diffraction pattern. The application of multidetectors or position sensitive detectors is discussed. In the neutron time-of-flight (TOF) diffraction a white pulsed neutron beam allows one to satisfy the Bragg law for all lattice spacing at a fixed scattering angle. The main charateristics of the TOF diffraction experiment are shortly outlined. In this method all non-forbidden Bragg reflections are recorded in one pattern simultaneously. The TOF technique is well-suited to study low symmetric or multiphased specimens, especially geological materials, requiring a large number of pole figures for mathematical texture analysis. Multidetector systems can be used to shorten the necessary time for experiments. The registration of all Bragg reflections of fixed scattering geometry is equivalent to the information of the inverse pole figure for the corresponding sample position. Having short exposition times this approach can be applied for in-situ investigations. The magnetic moments of neutrons can be used to study magnetic anisotropies in materials. Two different techniques are discussed. 20 refs.; 7 figs.

38700 **(JINR-R—14-86-857) Study of the localized vibrations of the hydrogen in solid solution Zr-O by inelastic neutron scattering.** Kraciun, K.N.; Morozov, S.I.; Natkanets, I.; Sumin, V.V. (Institutul de Reactori Nucleari Energetici, Pitesti (Romania); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702945/JAW.

Submitted to the journal Sov. Phys. - Solid State.

Dynamics of implanted hydrogen and oxygen atoms in zirconium was investigated at 293 and 80 K and at different concentrations of impurity atoms. Hydrogen vibration energy in solid solution ZrO/sub 0.25/H/sub 0.09/ Planck constantω ≃ 141 MeV is close to hydrogen vibration energy in σ phase of zirconium hydride (Planck constantω ≃ 138 MeV) changing under adequate conditions. In a specimen with law oxygen content ZrO/sub 0.03/H/sub 0.01/ hydrogen vibration energy coincides with maximum position of zirconium hydride optical band. It is suggested that, as in Ti-O-H system, at low oxygen content in Zr-O-H no complete suppression of hydride precipitation occurs. Data on structural analysis of ZrO/sub 0.37/ and ZrO/sub 0.37/D/sub 0.1/ alloys are given. The JINR Laboratory of Neutron Physics has been performed the investigation. 25 refs.; 5 figs.; 1 tab.

38701 **(JINR-R—14-87-629) Study of nonhomogeneous magnetized magnetic films with polarized neutrons.** Korneev, D.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702946/JAW.

Submitted to the journal Poverkhn.: Fiz., Khim., Mekh. and to the Conference on physics of condensed media on the IBR-2 reactor JINR, Sept., 1987, Dubna.

It is shown that with reflection of polarized neutrons from the surface of nonhomogeneous magnetic films one can judge about the spatial behaviour local magnetization vector M-vector(z). A theoretical method for interpretation of experimental results in order to determine the function M-vector(z) is proposed. 9 refs.

38702 **(JINR-R—17-87-553) Phase transition in the model of proton superionic crystal.** Dzhavadov, N.A.; Plakida, N.M. (AN Armyanskoj SSR, Erevan). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702948/JAW.

Submitted to the journal Sov. Phys. - Crystallogr. .

A model for order-disorder phase transition for protons on hydrogen bonds in superionic conductor like cesium hydrogen sulphates is proposed. Possible types of proton ordering in the structural transition D/sub 4h/^{19} -> C/sub 2h/^{5}, with doubling of the primitive cell volume are investigated by the concentration wave method. 16 refs.

38703 **(LA—11192-MS) A numerical study of Rayleigh-Taylor instability in aluminum and steel plates.** Daly, B.J. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010475/JAW.

The SCRAM code is applied to the study of Rayleigh-Taylor instability in metal plates, and comparisons of these computer results are made with experimental data for 1100-O aluminum, 6061-T6 aluminum and 304 stainless steel. Various models for the pressure, temperature, and strain-rate dependencies of the flow stress are compared in the computer calculations. The coefficients that are required in these models to give good agreement with the experimental results are generally close to values that were determined from previous experimental comparisons. The sensitivity of the computed results to modeling parameters, to variations in the hardening modulus, and to the amplitude and wavelength of the perturbations in the plate surface is examined. Very little growth in amplitude occurs if either the initial amplitude or the wavelength is sufficiently small. The growth rate increases monotonically with increasing initial amplitude. There appears to exist a wavelength of maximum growth, such that the growth rate increases rapidly with wavelength up to this wavelength, but then decreases slowly as the wavelength is further increased.

38704 **(LA-UR—88-1519) Muon spin depolarization in Gd- and EuBa$_2$Cu$_3$O/sub x/.** Cooke, D.W.; Hutson, R.L.; Kwok, R.S.; Maez, M.; Rempp, H.; Schillaci, M.E.; Smith, J.L.; Willis, J.O.; Lichti, R.L.; Chan, K.C.; Boekema, C.; Weathersby, S.; Oostens, J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880431—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010954/JAW.

From International conference on the first two years of high-{Tc} superconductivity; Tuscaloosa, AL, USA (11 Apr 1988).

Postive muon spin rotation (μSR) measurements on Gd- and EuBa$_2$Cu$_3$O/sub x/ (x ~ 7) have been conducted in the temperature interval 4-300K. For each sample, muons stop both at grain boundaries and within the superconducting grains. Measured magnetic field penetration depths are 1550 and 1900{angstrom} for two specimens of GdBa$_2$Cu$_3$O/sub x/, and 1350{angstrom} for EuBa$_2$Cu$_3$O/sub x/. 2 refs., 5 figs.

38705 **(LA-UR—88-1738) The Fog-oil anomaly confirmed in HELSMK-I tests.** Gerstl, S.; Chitanvis, S.; Zardecki, A.; Wallace, J.; Gebhardt, F.; Dekinder, B. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 7p. (CONF-8804108—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010927/JAW.

From 12. symposium on smoke/obscurants; Laurel, MD, USA (19 Apr 1988).

Modeling analyses of preliminary experimental data obtained from the High Energy Laser (HEL) beam propagation tests (HELSMK-I) through tactically significant smokes are presented for the case of Fog-oil (FO). Thermal imager data together with transmission measurements and other experimental evidence are used to reconstruct and model the interaction physics of the HEL

beam with FO. An earlier theoretical model by Wallace (1983) predicted that the high energy beam would vaporize large (>10μm) FO droplets, while the smaller droplets primarily conduct their energy to the ambient air, thereby enhancing thermal blooming in air. This behavior is categorized as an anomaly for the interaction of a HEL beam with aerosols because complete vaporization would normally have been expected. The HELSMK-I test together with computational results from our nonlinear beam propagation codes confirmed this prediction. Fog-oil can thus be classified as an effective smoke shield against a HEL threat in open air at infra-red wavelengths, at flux levels of a few tens of Kilowattscm^2. These results also validated our computer models which show that a punch-through effect is prevented in FO due to its enhanced blooming characteristics. 5 refs., 7 figs.

38706 **(SAND—88-0108) A comparison of analytical techniques for modeling the Rayleigh-Taylor response of elastic-plastic solids.** Robinson, A.C. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 34p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010372/JAW.

The Rayleigh-Taylor instability response of elastic-plastic solids can be modeled by approximate means. However, neither the linear elastic response equation nor the so-called {open←quotes}minimum amplitude{close←quotes} instability criterion derived from rigid plastic analyses is sufficient to describe overall stability characteristics at very large driving pressures. We compare several versions of the modal or one-degree-of-freedom approximation technique and indicate the common features which must be included to obtain the qualitative response seen in numerical experiments.

38707 **(UCID—21407) Results of initial phase conjugation experiments in CS_2 and CCl_4.** Milam, D.; Marshall, C.; Vercimak, C.; Moore, T. (Lawrence Livermore National Lab., CA (USA)). 17 May 1988. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number TI88010730/JAW.

A liquid with lower nonlinear refractive index, CCl_4, provided conjugated beams with clean near field distribution, unless astigmatism was added to the input beam. Astigmatism caused fringing on the conjugated beam. The tendency toward fringing was diminished in our more recent experiments in glass and methane. Measured thresholds and reflectances for both CS_2 and CCl_4 agreed with published results. Waveforms of pulses produced by SBS are different from those of the input pulse. Except for tansients observed on the leading edge, all aspects of the SBS wave form can be explained. Correction by conjugation in $CCl_4$for up to 4.5 waves of astigmatism provided beams with divergence not greater than twice the diffraction limit. Experimental error may account for some of the apparent divergence. 12 refs., 12 figs.

38708 **(UCRL—97218) Short pulse x-ray diffraction studies of shocked and annealed crystals using the JANUS research laser.** Lee, R.W.; Eckart, M.J.; Kilkenny, J.D.; Whitlock, R.R.; Hauer, A.; Wark, J.S. (Lawrence Livermore National Lab., CA (USA); Naval Research Lab., Washington, DC (USA); Los Alamos National Lab., NM (USA); Rochester Univ., NY (USA). Lab. for Laser Energetics). 1987. Contract W-7405-ENG-48. 15p. (CONF-8708110—38). NTIS, PC A03;3. Order Number DE88011329/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

When a crystal is annealed or shocked the spacing of the interatomic planes is altered, and a measurement of the lattice spacing can yield information on the temperature or compression respectively. We have used the JANUS research laser at LLNL to perform such measurements of transiently strained crystals. JANUS is a two-beam laser system, with separate synchronized oscillators for each beam. One beam of the laser, containing 10 - 100 J of 1.06μm light in a pulse of 1 ns FWHM, was found to a 3.9 cm diameter spot on the surface of silicon crystal; the crystal was either annealed or shock-compressed, depending on the absence or presence of a variety of thin coatings applied to the crystal surface. At some time during or after the perturbing pulse, the second synchronous but delayed laser beam, containing {approximately}10 J of 0.53μm light in a pulse of 100 ps (FWHM), was focused to a 40μm diameter spot onto a separate target containing calcium, potassium, and chlorine. Thus, a short pulse of the helium-like line radiation of these atoms was produced, and this radiation was Bragg diffracted from the surface of the strained crystal. Measurements of the change in Bragg angle, caused by thermal expansion or shock compression, gives a direct measurement of one component of the strain within the crystal. A single laser shot gives recordable x-ray levels. A number of shots at different irradiances and delay times gave information about the lattice spacing as a function of time. The potential applications of such results is discussed. 10 refs., 6 figs.

38709 **(UCRL—98862) Recent applications of the Boltzmann master equation to heavy ion precompound decay phenomena.** Blann, M.; Remington, B.A. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 11p. (CONF-8806144—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011721/JAW.

From 5. international conference on nuclear reaction mechanisms; Villa Monastero, Italy (13 Jun 1988).

The Boltzmann master equation (BME) is described and used as a tool to interpret preequilibrium neutron emission from heavy ion collisions gated on evaporation residue or fission fragments. The same approach is used to interpret neutron spectra gated on deep inelastic and quasi-elastic heavy ion collisions. Less successful applications of BME to proton inclusive data with 40 MeV/u incident ^{12}C ions are presented, and improvements required in the exciton injection term are discussed.

38710 **Crystallization of fcc (111) and (100) crystal-melt interfaces: A comparison by molecular dynamics for the Lennard-Jones system.** Burke, E.; Broughton, J.Q.; Gilmer, G.H. (Department of Materials Science, S.U.N.Y. Stony Brook, Stony Brook, New York 11794). *Journal of Chemical Physics;* **89**: No. 2, 1030-1041(15 Jul 1988).

The crystal growth rates of Lennard-Jones fcc (face-centered cubic) (111) and (100) faces into the melt have been studied as a function of undercooling by molecular dynamics. The (100) grows without activation energy barrier at rates determined by the difference in the free energies of the crystal and melt phases, and the arrival rate of atoms across a plane determined from the kinetic theory of gases. The maximum velocity occurs at approximately half the melting point and represents 80 m/s for argon. The (111), on the other hand, grows at rates two to three times lower than this; the exact rate being size dependent. The growth kinetics are now activated and resemble Wilson—Frenkel behavior. However, the step responsible for such activation is not the simple liquid diffusion of Wilson—Frenkel theory, but rather the concerted motion of atoms at the interface selecting either all fcc or all hcp (hexagonal close packed) triangular lattice sites before a layer can grow.

38711 **Collective effects in electronic sputtering of organic molecular ions by fast incident cluster ions.** Salehpour, M.; Fishel, D.L.; Hunt, J.E. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **64**: No. 2, 831-834(15 Jul 1988).

The collective sputtering effect of fast primary cluster ions on the yield of secondary molecular ions has been demonstrated for the first time. Results show that the sputtering yield of valine negative molecular ions per incident carbon atom, in a C+/sub n/ incident cluster ion, increases with increasing n. The yield results are interpreted as a direct effect of the enhancement in the electronic stopping power per atom in cluster ions compared to atomic ions.

38712 **Quantum-mechanical cluster-lattice interaction in crystal simulation: Hartree-Fock method.** Kunz, A.B.; Vail, J.M. (Department of Physics, Michigan Technological University, Houghton, Michigan 49931). *Physical Review [Section] B: Condensed Matter;* **38**: No. 2, 1058-1063(15 Jul 1988).

The problem of describing quantum mechanically a region of interest in an otherwise extended lattice is discussed for nonmetallic solids. A localizing potential to accomplish this is described, and its implications for the total-energy algorithm are analyzed. A spurious

tunneling effect that may arise with a finite embedding lattice is also discussed.

38713 **Quantum-mechanical cluster-lattice interaction in crystal simulation: Many-body effects.** Kunz, A.B.; Meng, J.; Vail, J.M. (Department of Physics, Michigan Technological University, Houghton, Michigan 49931). *Physical Review [Section] B: Condensed Matter;* **38**: No. 2, 1064-1066(15 Jul 1988).

The problem of describing quantum mechanically a region of interest in an otherwise extended lattice is discussed for nonmetallic solids. Hartree-Fock effects were considered in the preceding work, and in the present paper we consider the application of a many-body perturbation-theory correlation correction. The application of this formalism to NaF crystals containing Cu is considered as an illustration of the method. These results tend to validate the total procedure including the utility of correlation corrections for such problems.

38714 **Nonequilibrium transport of an electron-phonon-hole system in a semiconductor quantum well.** Zheng, T.F.; Cai, W.; Lax, M. (Department of Physics, City College of the City University of New York, New York New York 10031). *Physical Review [Section] B: Condensed Matter;* **38**: No. 2, 1406-1416(15 Jul 1988).

The recently developed transport theory of two-dimensional carriers has been applied to an electron-lattice-hole system with an applied electric field in GaAs-Ga/sub 1-//sub x/Al/sub x/As heterojunction. The renormalized carrier-carrier coupled potentials and the renormalized carrier-phonon coupled potentials (including hole-lattice deformation potential) are derived in the ring diagram approximation. Force and energy balance equations of electrons and holes are obtained by a nonequilibrium density operator technique. These four balance equations are solved numerically in the steady state. The result shows that the electrons are heated in the applied electric field much more than the holes and the electron-hole interaction enhances the energy and momentum loss rate of electrons. These results are in agreement with recently experimental data.

38715 **Low-temperature properties of the two-impurity Kondo Hamiltonian.** Jones, B.A.; Varma, C.M.; Wilkins, J.W. (Laboratory of Atomic and Solid State Physics, Clark Hall, Cornell University, Ithaca, New York 14853 and AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, New Jersey 07974). *Physical Review Letters;* **61**: No. 1, 125-128(4 Jul 1988).

For the two-impurity Kondo system, the low-temperature properties: impurity spin-spin correlation function, susceptibilities, specific heat, and Wilson ratio: are strongly nonuniversal functions of the ratio (I_0/T/sub K/) of the Ruderman-Kittel-Kasuya-Yosida coupling to the single-impurity Kondo temperature. In particular, there is a new unstable fixed point for an antiferromagnetic coupling with I_0/T/sub K/$\approx$2.2. The calculations utilize a newly found symmetry of Kondo Hamiltonians, axial charge.

38716 **Stimulated two-photon annihilation of positrons channeled in crystals.** Kurizki, G.; Friedman, A. (Chemical Physics Department, Weizmann Institute of Science, Rehovot, Israel 76100). *Physical Review [Section] A: General Physics;* **38**: No. 1, 512-514(1 Jul 1988).

It is pointed out that the emission of photons in the GeV range produced by the annihilation of channeled positrons can be stimulated by superfluorescent emission of characteristic radiation in the MeV range from a beam of channeled electrons or positrons. The threshold current for the entire process is $\sim$10/sup 10/ times lower than that of stimulated Compton scattering of visible light into the MeV range of frequencies.

38717 **Bulk elastic wave propagation in partially saturated porous solids.** Berryman, J.G.; Thigpen, L.; Chin, R.C.Y. (Lawrence Livermore National Laboratory, P.O. Box 808, L-156, Livermore, California 94550). *Journal of the Acoustical Society of America;* **84**: No. 1, 360-373(Jul 1988).

The linear equations of motion that describe the behavior of small disturbances in a porous solid containing both liquid and gas are solved for bulk wave propagation. The equations have been simplified by neglecting effects due to changes in capillary pressure. With this simplifying assumption, the equations reduce to two coupled (vector) equations of the form found in Biot's equations (for full saturation) but with more complicated coefficients. As in fully saturated solids, two shear waves with the same speed but different polarizations exist as do two compressional waves with distinct speeds. Attenuation effects can be enhanced in the partially saturated solid, depending on the distribution of gas in the pore space. Two models of the liquid/gas spatial distribution are considered: a segregated-fluids model and a mixed-fluids model. The two models predict comparable attentuation when the gas saturation is low, but the segregated-fluids model predicts a more rapid roll-off of attenuation as the gas saturation increases.

38718 **Chemical and elastic effects on isostructural phase diagrams: The epsilon-c-G approach.** Ferreira, L.G.; Mbaye, A.A.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review [Section] B: Condensed Matter;* **37**: No. 18, 10547-10570(15 Jun 1988).

Numerous theoretical models of temperature-composition phase diagrams of isostructural binary alloys are based on the configurational Ising Hamiltonian in which the many-body configurational interaction energies epsilon-c/sup (//sup n//sup)/ are taken as (volume-independent) constants (the "epsilon-c-only" approach). Other approaches postulate phenomenologically composition-dependent but configuration- (σ-) independent elastic energies. We show that under the commonly encountered situation where molar volumes at fixed composition (x) do not depend on the state of order, a new approach is pertinent: We prove that the physically relevant Hamiltonian (the "epsilon-c-G approach") includes the configuration-dependent (but concentration-independent) "chemical" interaction energies epsilon-c/sup (//sup n//sup)/, plus a composition-dependent (but configuration-independent) elastic energy G(x). We compute the elastic term G(x) from the structural and elastic properties of ordered intermetallic systems. We show that inclusion of G(x) into the conventional configurational (epsilon-c-only) Hamiltonian cures many of the shortcomings of such Ising models in describing actual alloy phase diagrams.

38719 **Polytope models for local icosahedral packing: An electronic structure analysis.** Phillips, R.B.; Carlsson, A.E. (Department of Physics, Washington University, St. Louis, Missouri 63130). *Physical Review [Section] B: Condensed Matter;* **37**: No. 18, 10880-10883(15 Jun 1988).

The electronic properties of recently developed icosahedral packing schemes using polytope {3,3,5} (a packing of atoms on S_3, the surface of the unit sphere in four dimensions, with perfect icosahedral symmetry) are analyzed within the framework of a d-band, tight-binding model. It is shown that there is a one-parameter family of prescriptions for defining the interatomic couplings, which preserves the icosahedral symmetry and generalizes earlier schemes. The bonding energies for several representative cases are calculated and compared to those in the fcc structure. The results are extremely sensitive to the prescription used to define the couplings.

38720 **Frenkel-Kontorova model with nonconvex-interparticle interactions and strain gradients.** Marianer, S.; Bishop, A.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9893-9896(1 Jun 1988).

We study the statics and dynamics of a chain of atoms moving in a periodic potential with nonlinear, nonconvex interparticle interactions, and with strain gradients which we model by including next-nearest-neighbor interactions through the discrete Hamiltonian H = +u/sub n/-1)^2-cos u/sub n/. We obtain the phase diagram within an ansatz of periodically modulated configurations. These generalize the homogeneous (for β<(18) and dimerized (for β>(18) configurations reported previously for γ = 0, and are given by u/sub n/ = na_1+b_1 for n = 1,...,N and u/sub n/ = na_2+b_2 for n = N+1,...,M. The dynamics of transitions between different configurations when the parameters are varied is also investigated and we show that these are dominated by nucleation processes, which occur on short time scales compared with the subsequent slow growth. The possible relevance of the model to the

dynamics of twin boundaries recently observed in the copper-oxide high-temperature superconductors is discussed.

38721 **Theoretical calculations of phase transitions in the megabar regime.** Cohen, M.L. (Dept. of Physics, Univ. of California, and Materials and Chemical Sciences Div., Lawrence Berkeley Lab., Berkeley, CA (US)). *Scripta Metallurgica;* 22: No. 2, 127-132(Feb 1988). Contract AC03-76SF00098.

There is a delicate balance between the various components of the Coulomb energy which hold crystalline solids together. These components depend sensitively on the structural arrangements of the atoms and their separations. High pressure experiments provide a useful probe of the interactions since volumes and, in turn, lattice constants are varied in a manner which can be simulated theoretically. Hence, various properties and phase transitions can be examined as a function of pressure. Some of the most dramatic of these include structural, insulator-metal, and superconducting transitions. Theoretical approaches such as the pseudopotential method are capable of explaining and predicting pressure-dependent properties using only information about the constituent atoms composing the solid. In particular, for the calculations described here, only the atomic numbers and masses are used to test the energies and properties of candidate crystal structures.

38722 **Phase-matched harmonic generation in single microcrystals.** Velsko, S.P. (Lawrence Livermore National Lab., Nonlinear Optical Materials Group, P.O. Box 5508, Livermore, CA 94550 (US)). pp 78 of XV international conference on quantum electronics (Digest of technical papers). Washington, DC; Optical Society of America (1987). (CONF-870488—).

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Technical Paper TUHH 4.

The phase-matched harmonic generation parameters determining the conversion efficiency of a nonlinear material are the effective nonlinear coupling, angular sensitivity, and temperature bandwidth. In practice, it is very difficult to extract an accurate estimate of these parameters from the traditional powder measurements because of systematic bias in the orientational distributions of the particles and because several distinct phase-matching conditions may contribute to the powder signal. Until now, rapid unambiguous characterization of new nonlinear materials has been hampered by the perceived necessity of growing large (cm^3) sized single crystals for linear and nonlinear optical measurements. The authors developed a method for directly measuring second harmonic generating efficiencies in single crystals as small as 300 μm.

6561 Superconductivity

REFER ALSO TO CITATION(S) 36734, 36738, 36760, 36777, 36781, 36845, 36851, 36852, 36853, 36856, 36859, 36863, 36866, 36868, 36874, 36875, 36882, 36883, 36893, 36894, 36904, 36905, 36906, 36908, 36909, 36910, 36911, 36912, 38704

38723 **(IFVE-OTF—87-98) Relativistic theory of gravitation and its consequences.** Logunov, A.A.; Loskutov, Yu.M.; Mestvirishvili, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 40p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702861/JAW.

Submitted to the journal Sov. Phys. - Usp. .

The paper gives a brief critical analysis of General Relativity Theory (GRT). It is shown that the theory, if accepted, leads to repudiation of a number of fundamental principles underlying physics. It expounds Relativistic Theory of Gravitation (RTG) in which the gravitational field possesses all the attributes of physical fields and which is consistent completely with the fundamental physical principles as well as with the experimental and observational facts available. It also considers the consequences of RTG dealing, in particular, with the development of collapse and Universe evolution. 47 refs.

38724 **(INIS-BR—1075, pp 9) Study of superconducting transitions in some many valley semiconductors.** Silveira, H.V. da; Cerdeira, H.A. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38725 **(JINR-E—17-87-198) Anharmonic model for high-T/sub c/ superconductors.** Plakida, N.M.; Aksenov, V.L.; Drechsler, S.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Akademie der Wissenschaften der DDR, Dresden. Zentralinstitut fuer Festkoerperphysik und Werkstofforschung). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702919/JAW.

Submitted to the journal Europhys. Lett. .

A considerable enhancement of the superconducting transition temperature T/sub c/ in perovskite oxide compounds is explained in the framework of the anharmonic model for superconductors with structurally unstable lattices. It is shown that anharmonic local excitations with fluctuation amplitudes much greater than harmonic vibrations amplitudes lead to a considerable enhancement of the coupling constant λ. The obtained estimations for T/sub c/ are in agreement with experimental data for La(Y)BaCuO systems. 17 refs.

38726 **(LBL—24111) Properties of new low dimensional materials and mechanisms of high T/sub c/ superconductivity.** Kresin, V.Z. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 25p. (CONF-870766—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012026/JAW.

From International conference on high temperature superconductivity; Philadelphia, PA, USA (29 Jul 1987).

The new low dimensional high T/sub c/ superconductors are characterized by unusual vales of normal and superconducting parameters, by peculiar behavior of the thermal conductivity. It is possible to observe a multigap structure. High T/sub c/ is due to the coexistence of the phonon and plasmon mechanisms. Proximity systems containing high T/sub c/ superconductors are promising from the point of view of building a three-terminal device and obtaining a high critical current.

38727 **(LBL—25360) Research and development of superconductivity in the USA.** Clarke, J. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 22p. (CONF-8805148—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012016/JAW.

From 25. anniversary meeting of the Metal Mining Agency; Tokyo, Japan (27 May 1988).

In this paper, the author focuses his attention on the present and potential applications of superconductors -- both the classic low T/sub c/ superconductors such as niobium and its alloys and the new high-T/sub c/ materials. This discussion falls naturally into two broad areas: large scale applications such as magnets and power generators, and small scale applications such as ultrasensitive detectors of electromagnetic radiation and of tiny magnetic fields;

38728 **(NBI-HE—87-80) Observation of the Meissner effect in a lattice Higgs model.** Damgaard, P.H.; Heller, U.M. (Niels Bohr Inst., Copenhagen (Denmark); California Univ., Santa Barbara (USA). Inst. for Theoretical Physics). Dec 1987. 9p. (NSF-ITP—87-141i). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753282/JAW.

The lattice-regularized U(1) Higgs model in an external electromagnetic field is studied by Monte Carlo techniques. In the Coulomb phase of this model we demonstrate that magnetic flux can flow through uniformly, whereas in the Higgs phase two regions separate out: a type-II phase where magnetic flux can penetrate only in the form of vortices, and a type-I phase where the magnetic flux is completely expelled. This is the relativistic analogue of the Meissner effect in superconductivity. Furthermore, we present numerical evidence that the Higgs region of the phase diagram dimin-

ishes as the magnetic field increases. This is the Higgs model analogue of the disappearance of the superconducting state in strong magnetic fields.

38729 **Theory of how to distinguish a scalar from a tensor order parameter in the high-T/sub c/ superconductors.** Brand, H.R.; Doria, M.M. (Center for Nonlinear Studies, MS-B258, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **37**: No. 16, 9722-9725(1 Jun 1988).

Using generalized Ginzburg-Landau equations, we discuss the possibility that the high-T/sub c/ superconductors do not have a scalar, but a tensor order parameter. We propose experiments to distinguish between these two possibilities both with lattice anisotropy included. A tensor order parameter implies a splitting of the upper critical field for a given setup as well as the appearance of a transverse magnetic field, when a field is applied parallel to the crystal cell axes. Only for a single scalar, the product of coherence and penetration lengths is an invariant along the cell axes.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 36978, 37308, 37650, 38316, 38342, 38440, 38584, 38598, 38608

38730 **(CONF-8805129—1) Boundary element method for contact heat transfer.** Gray, L.J.; Askew, A.L.; Giles, G.E. (Oak Ridge National Lab., TN (USA); Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Apr 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011013/JAW.

From European boundary element meeting; Brussels, Belgium (8 May 1988).

The (steady state) heat flow between two contacting solids is investigated utilizing an efficient new boundary element method for treating thin cavities. A significant advantage of this approach is that a (multidomain) decomposition of the region is avoided and the contact region remains an interior surface. Consequently, the discontinuous flux across the contact/non-contract boundary is not solved for directly and no special provisions for the singularity are required. These fluxes can be accurately obtained after the boundary integral equation has been solved and all boundary values are known. Calculations for a circular contact region are presented, and the results are compared against a known analytic solution. Since pevious work on this method has only considered interior cavities and the contact gap is a 'surface crack', the treatment of surface cracks will also be described. 15 refs., 8 figs.

38731 **(DOE/ER/13740—1) Investigation of transitions from order to chaos in dynamical systems: Progress report.** Schmidt, G. (Stevens Inst. of Tech., Hoboken, NJ (USA). Dept. of Physics and Engineering Physics). Mar 1987. Contract FG02-87ER13740. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007290/JAW.

This paper discusses the use of strange attractors to describe dissipative systems, and Hamiltonian chaotic dynamics applied to free electron lasers. (LSP)

38732 (INIS-BR—1018, pp 23) **Constants of motion for general mechanic systems.** Espindola, O.; Espindola, M.L.; Teixeira, N.L. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38733 (INIS-BR—1018, pp 27) **Infinite systems of classical particles.** Matos Neto, A.; Vianna, J.D.M. (Bahia Univ., Salvador (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38734 (INIS-BR—1018, pp 29) **R.H.S. for infinite well.** Silva Junior, O.S. (Sergipe Univ., Aracaju (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38735 (INIS-BR—1018, pp 31) **Classical propagator theory applied to undulatory mechanics in phase space.** Santana, A.E.; Matos Neto, A.; Vianna, J.D.M. (Bahia Univ., Salvador (Brazil). Inst. de Fisica; Brasilia Univ. (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38736 **(INIS-BR—1075) Proceedings of the 3. Workshop on Statistical Mechanics and Field Theory.** (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1985. 25p. (In Portuguese). (CONF-8512148—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW.

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

The present progresses reached in statistical mechanics and field theories by Brazilian reseachers are presented. (M.C.K.).

38737 (INIS-BR—1075, pp 6) **Anomalous quantizated Hall effect.** Studart, N. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38738 (INIS-BR—1075, pp 6) **Quantum Brownian movement: present progress.** Caldeira, A.O. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38739 (INIS-BR—1075, pp 11) **Group of renormalization in the micro-canonical ensemble: Why not.** Tsallis, C. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38740 (INIS-BR—1075, pp 12) **Inter chirality versus external chirality.** Kurak, V.; Bosco, F.A.R. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38741 (INIS-BR—1075, pp 17) **Effects of Coulomb interaction on 'Goldstone bosons' in the state of spin wave density.** Kurihara, Y. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38742 (INIS-BR—1075, pp 18) **Expansions of free energy for Ising model in a random field.** Silva, P.R. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38743 (INIS-BR—1075, pp 18) **Superalgebra in the spin glass theory.** Theumann, A. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38744 (INIS-BR—1075, pp 20) **Hierarchic model which shows fixed Kosterlitz - Thouless point.** Marchetti, D.H.U.; Perez, J.F. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38745 (INIS-BR—1075, pp 20) **Stationary states in photo-excited semi-conductors.** Castro, T.T.M. de. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38746 (INIS-BR—1075, pp 20) **Considerations on extended irreversible thermodynamic.** Vasconcellos, A.R.; Luzzi, R. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38747 (INIS-BR—1075, pp 21) **Long Ranged Ferromagnetic (LRF) Model with external magnetic field.** Caliri, A. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38748 (INIS-BR—1075, pp 24) **Non ideal Bose gas: domain walls and excitation spectrum.** Ventura, I.; Vitiello, S. 1985. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702773/JAW. (CONF-8512148—).

From 3. workshop on statistical mechanics and field theory; Sao Carlos, Brazil (11 Dec 1985).

38749 (INIS-mf—11219, pp 235-236) **Factorization of two vector operators for the Coulomb problem.** De Lange, O.L.; Raab, R.E. (Physics department, University of Natal, Pietermaritzburg, South Africa). 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702802/JAW. (CONF-8707166—).

From 22. annual seminar on theoretical physics; Durban, South Africa (14 Jul 1987).

Included in the constants of the motion of the classical Coulomb problem are the orbital angular momentum vector L and the Laplace-Runge-Lenz vector A/sub c/ and therefore the vector B/sub c/ = vector A/sub c/ x vector L.[1] Some of the conserved quantum-mechanical operators for this problem are vector L = vector r x vector p, the Pauli-Lenz vector A and the vectors B^{+-} = vector A x vector L[Planck constant(S +- 12)]$^{-1}$, S = (vector L^2Planck constant^2 + 14)$^{-1}$2. The last are defined such that the operators vector C^{+-} = A +- i vector B^{+-} are ladder operators for l in the eigenkets nlm>. It is shown that vector C^{+-} can be factorized in two different ways.

38750 (INIS-mf—11223, pp 427-442) **Shifted large N expansions in quantum mechanics.** Sukhatme, U.P. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique Theorique et Hautes Energies; Chicago Univ., IL (USA). Dept. of Physics). 1984. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702874/JAW. (CONF-8405236—).

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

Large N expansions, where N is the number of spatial dimensions, constitute a powerful, new technique for determining the eigenstates of the Schroedinger equation, even for potentials which are in no sense "small". I discuss a somewhat modified, physically motivated approach which yields "shifted large N expansions". This method incorporates exactly known analytic results into large N expansions, greatly enhancing their accuracy, simplicity, convergence and range of applicability. Results for numerous physically interesting potentials are presented. 12 refs., 2 figs.

38751 (INIS-SU—47) **Applications of continual integrals to solution some inverse problems for three-dimensional Schroedinger equation.** Gestrin, G.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1986. 35p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702883/JAW.

Preprint-56-86.

Nonlinear integral equations of the 2-nd kind for the known inverse problems of the spectral theory of Schroedinger operator H=-Δ+v(r-vector) are deduced from the solution of initial value problem presented in the form of the continual wilner integral. New theorems and formulae connecting the spectral kernel of the family of operators with the potential v(r-vector) are given. 16 refs.

38752 (JINR-E—5-87-400) **Dissipative Lax-Phillips scattering theory and the characteristic function of a contraction.** Neidhardt, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702912/JAW.

Submitted to the journal Rev. Roum. Math. Pures Appl. .

The paper deals with the problem to characterize all those contractions admitting a dissipative Lax-Phillips scattering theory. The characterization is given in terms of the characteristic function of contraction and its unitary part. Moreover, the problem is considered and solved to describe all those completely contractions which can be orthogonally enlarged by a unitary operator such that the sum admits an orthogonal dissipative Lax-Phillips scattering theory. 8 refs.

38753 (JINR-E—17-87-574) **Generalized N-level single-mode Jaynes-Cummings model.** Kochetov, E.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702921/JAW.

Submitted to the journal Phys. A.

A quantum statistical model for the interaction of an N-level atom with a single mode radiation field is presented. A complete system of eigenfunctions and eigenvalues is found. Application of this model to the investigation of photon antibunching and squeezing effects is also discussed. 38 refs.

38754 (JINR-R—2-87-453) **Spheroidal basis of the four-dimensional isotropic oscillator.** Davtyan, L.S.; Mardoyan, L.G.; Pogosyan, G.S.; Ter-Antonyan, V.M.; Sisakyan, A.N. (Erevanskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702928/JAW.

Submitted to the journal Teor. Mat. Fiz. .

Four-dimensional spheroidal coordinates are introduced. Complete set of spheroidal wave functions of a four-dimensional isotropic oscillator generalizing a spheroidal basis of a hydrogen atom is studied. The integral of motion specific for the spheroidal analysis is derived and by means of this integral the algebraization of the problem in question is carried out. the iteration method is proposed for calculating spheroidal corrections to the noncanonic and double-polar basis of the four-dimensional isotropic oscillator. 8 refs.

38755 **(JINR-R—5-87-284) Numerical algorithm for solution of the inverse scattering problem.** Egikyan, R.S.; Zhidkov, E.P. (Erevanskij Fizicheskij Inst. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702934/JAW.

The problem of restorting a potential in Schroedinger equation through scattering data is considered. Stable, direct algorithm for its solution by means of Fourier transform is suggested. Numerical results for the Bargmann potentials are presented. 11 refs.; 3 tabs.

38756 **(LAPP-TH—199-87) 2d SUGRA: supersymmetric form of the effective action leading to the conformal anomaly.** Gieres, F.; McCabe, J. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Sep 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753969/JAW.

For the 2-dimensional (1.1) and (1.0) supergravity we construct the locally supersymmetric effective Lagrangian whose superconformal variation leads to the conformal anomaly.

38757 **(NORDITA—87/69-P-Prepr.) Note on Bell's inequalities for stochastic hidden variables theories.** Oegren, M. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753289/JAW.

We have derived Bell's inequalities for a Bell-Bohm singlet spin system when the correlation is not perfect, under assumptions that are weaker than determinism or microscopic factorizability.

38758 **(UCID—20972) Wave equations for pulse propagation.** Shore, B.W. (Lawrence Livermore National Lab., CA (USA)). 24 Jun 1987. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011760/JAW.

Theoretical discussions of the propagation of pulses of laser radiation through atomic or molecular vapor rely on a number of traditional approximations for idealizing the radiation and the molecules, and for quantifying their mutual interaction by various equations of propagation (for the radiation) and excitation (for the molecules). In treating short-pulse phenomena it is essential to consider coherent excitation phenomena of the sort that is manifest in Rabi oscillations of atomic or molecular populations. Such processes are not adequately treated by rate equations for excitation nor by rate equations for radiation. As part of a more comprehensive treatment of the coupled equations that describe propagation of short pulses, this memo presents background discussion of the equations that describe the field. This memo discusses the origin, in Maxwell's equations, of the wave equation used in the description of pulse propagation. It notes the separation into lamellar and solenoidal (or longitudinal and transverse) and positive and negative frequency parts. It mentions the possibility of separating the polarization field into linear and nonlinear parts, in order to define a susceptibility or index of refraction and, from these, a phase and group velocity. The memo discusses various ways of characterizing the polarization characteristics of plane waves, that is, of parameterizing a transverse unit vector, such as the Jones vector, the Stokes vector, and the Poincare sphere. It discusses the connection between macroscopically defined quantities, such as the intensity or, more generally, the Stokes parameters, and microscopic field amplitudes. The material presented here is a portion of a more extensive treatment of propagation to be presented separately. The equations presented here have been described in various books and articles. They are collected here as a summary and review of theory needed when treating pulse propagation.

38759 **(UCRL—98822) Staggered-grid finite element solution technique for the Maxwell's equations in the time domain.** Lee, R.L.; Madsen, N.K. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 8p. (CONF-8806147—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011731/JAW.

From 1. Woodward conference on wave phenomena theoretical, computational and practical aspects; San Jose, CA, USA (2 Jun 1988).

In this paper, the authors present a two-dimensional Galerkin finite element formulation of the Maxwell's equations in the time domain. The Galerkin element integrals are computed analytically and an explicit forward-backward time integration scheme is employed for advancing the resulting set of ordinary differential equations in time. The authors will compare two formulations of the simple 4-node bilinear element: (i) an equal-order interpolation element in which both the electric field and the magnetic field are approximated by bilinear basis functions; and (ii) a mixed-interpolation element in which the electric field is approximated as piecewise constant and the magnetic field as piecewise bilinear functions. The mixed formulation may be viewed as a finite element analog to certain staggered finite difference representations. Numerical examples will be presented to evaluate the accuracy of these two elements.

38760 **Evolving geometric phase and its dynamical manifestation as a frequency shift: An optical experiment.** Simon, R.; Kimble, H.J.; Sudarshan, E.C.G. (The Institute of Mathematical Sciences, C.I.T. Campus, Madras 600chemical bond113, India). *Physical Review Letters;* **61**: No. 1, 19-22(4 Jul 1988).

We show that an evolving geometric phase induces a frequency shift. We report an optical experiment where we employ this effect to offset the frequency of a laser beam.

38761 **Theory of laser beam apodization with a graded random phase window.** Haas, R.A. (University of California-Davis, Department of Applied Science, Livermore, California 94550). *Applied Optics;* **27**: No. 13, 2708-2718(1 Jul 1988).

Analysis indicates that graded random phase modulation can be used to apodize a laser beam. In the case of an obscuration or hard edge, it can prevent the formation of Fresnel diffraction ripples. For example, suppose laser radiation of wavelength Σ interacts with a central obscuration of halfwidth a followed immediately by a window. If the exit surface of the window is randomly modulated with a Gaussian amplitude transverse correlation length l and a mean square amplitude $\sim(t^2)$ (r) that decreases smoothly from a peak height at the obstacle of $\sim\Sigma^2$ with a transverse scale length L } a >> l, then the Fresnel diffraction ripples normally produced by the obscuration are eliminated. Following the apodizer the laser beam consists of two components. One is widely scattered with mean intensity I-bar/sub s/. The other is essentially unscattered and apodized with mean intensity I-bar/sub a/. The scattered light has an angular divergence proportional to Σ/l. The apodizer intensity transmission is T/sub a/ = exp[-$\alpha^2 \sim(t^2)$= (r)], where $\alpha = 2\pi(n - 1)/\Sigma$ and n is the window refractive index. Tayloring $\sim(t^2)$ (r) can produce desired apodization profiles for hard edges and obscurations. Interference between the scattered and unscattered radiation produces intensity fluctuations on the laser beam that have the characteristics of laser speckle. The magnitude of these fluctuations is greatest near the apodizer and at the edge of the apodized beam. The local intensity probability density of the fluctuations is approximately the modified Rician density.

38762 **Self-organized criticality.** Bak, P.; Tang, C.; Wiesenfeld, K. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] A: General Physics;* **38**: No. 1, 364-374(1 Jul 1988).

We show that certain extended dissipative dynamical systems naturally evolve into a critical state, with no characteristic time or length scales. The temporal "fingerprint" of the self-organized critical state is the presence of flicker noise or 1/f noise; its spatial signature is the emergence of scale-invariant (fractal) structure.

38763 **Statistical entropy and a qualitative gas-liquid phase diagram.** Wallace, D.C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 1, 469-472(1 Jul 1988).

For a classical monatomic fluid, gas and liquid phases are differentiatedon the basis of their statistical-mechanical entropy expressions. In the customary picture of a gas, each particle is first

allowed to move independently over the entire volume; interactions are then introduced, and the configurational entropy becomes 1 minus the interaction corrections. In a liquid, the configurational entropy is assumed to be dominated by correlations, and is expressed as S/sup (2)/ plus higher-order correlation corrections, where the two-particle term S/sup (2)/ is of order -2. For liquid argon at 85 K on the saturation curve, S/sup (2)/ is evaluated from the measured radial distribution function, and the entropy is accurately given by liquid statistical theory, with the higher-order correlation corrections being approximately 13% of the magnitude of S/sup (2)/. A qualitative gas-liquid phase diagram is drawn for a classical monatomic fluid.

38764 Standard form of four-dimensional symplectic quadratic maps. Mao, J. (Department of Physics, University of Houston, Houston, Texas 77004). *Physical Review [Section] A: General Physics;* 38: No. 1, 525-526(1 Jul 1988).

It is shown that all four-dimensional symplectic quadratic maps generated by a generating function should be in a form that can be transformed into two coupled (two-dimensional) Henon maps. The latter is called the standard form of the four-dimensional symplectic quadratic map.

38765 Cyclotron motion in a Penning trap microwave cavity. Brown, L.S.; Gabrielse, G.; Tan, J.; Chan, K.C.D. (Department of Physics, FM-15, University of Washington, Seattle, Washington 98195). *Physical Review [Section] A: General Physics;* 37: No. 11, 4163-4171(1 Jun 1988).

The cavity shifts in the cyclotron motion of a charged particle in a hyperbolic Penning trap are described using a numerical evaluation of the cavity-mode structure. The frequency shifts are about half as large in the hyperbolic cavity as in a cylindrical cavity of equivalent size. However, this still implies an error in the g-2 experiment that is easily five times the present statistical uncertainty. To account for slit electrodes and imperfect tolerances in existing traps, experimental measurements of the mode structure are still needed. The resonant frequencies of a microwave cavity can be measured very precisely. We show here that an accuracy of 10% in the measurements of certain coupling constants is sufficient to compute the shifts for the g-2 experiment at the level of one part in 10^9.

38766 Three-state systems driven by resonant optical pulses of different shapes. Carroll, C.E.; Hioe, F.T. (Department of Physics, St. John Fisher College, Rochester, New York 14618). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 6, 1335-1340(Jun 1988).

New analytic solutions to the problem of a three-state system driven simultaneously by resonant optical pulses of different shapes are presented. The solutions are useful for prescribing the conditions for complete population transfer from one state to another or for complete population return.

38767 Statistical and signal processing concepts in surface metrology. Church, E.L.; Takacs, P.Z. (USA ARDEC, Dover, NJ (US)). pp 107-115 of Optical manufacturing, testing and aspheric optics. Sanger, G.M. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860366—).

From SPIE technical symposium on applications of artificial intelligence; Orlando, FL, USA (31 Mar 1986).

This paper proposes the use of a simple two-scale model of surface roughness for testing and specifying the topographic figure and finish of synchrotron-radiation mirrors. In this approach the effects of figure and finish are described in terms of their slope distribution and power spectrum, respectively, which are then combined with the system point spread function to produce a composite image. The result can be used to predict mirror performance or to translate design requirements into manufacturing specifications. Pacing problems in this approach are the development of a practical long-trace slope-profiling instrument and realistic statistical models for figure and finish errors.

70 FUSION ENERGY

38768 (INIS-mf—11221) Book of abstracts. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska). 22 Apr 1987. 249p. (CONF-8705172—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88702803/JAW.

From 18. European conference on laser interaction with matter; Prague, Czechoslovakia (4 May 1987).

The document contains abstracts of 24 review papers, 24 invited papers, 24 oral contributions and 120 posters. 10 review papers summarize the status of laser fusion research and progress in high-power laser facilities in major world laboratories. Four papers review research programs (laser-matter interaction studies and X-ray source development) based on KrF laser systems. Other review papers discuss the problems of laser energy conversion into X-rays in laser-heated cavities, X-ray lasing at shorter wavelengths, optimization of targets for inertial fusion. Two review papers are devoted to light ion fusion. The subjects of most invited papers are special problems of current laser plasma research, such as hot electron generation, nonlinear resonance absorption, energy accumulation limits, pellet ignition, conversion of laser light into X-rays, high-pressure plasma generation. Three invited papers review laser plasma research in Czechoslovakia, Poland and Spain. One paper suggests a new method of producing muonic superdense matter. The remaining inivited papers deal with the progress in XUV lasers and with laser plasma applications for further laser development. Of the papers accepted for oral presentation 12 papers discuss various problems of laser-plasma interaction; 4 papers deal with laser targets, 4 papers with laser-initiated X-ray sources, 3 papers with the diagnostics of laser-produced plasma. The last oral contribution presents the main principles of the excimer laser theory. The largest group of posters is related to laser-plasma interaction and energy absorption problems, to laser-target interaction and various methods of laser plasma diagnostics. The other posters deal with plasma applications in laser development, plasma mirrors, Brillouin and Raman scattering, X-ray emission, harmonic generation, electron acceleration, production of high-Z plasmas and other related problems. (J.U.).

38769 (JET-R—87-06) Results of the Joint European Torus. Green, B.J. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1987. 39p. (CONF-870515—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753516/JAW.

From Spring college on plasma physics; Miramare, Italy (25 May 1987).

The paper is a lecture given to the Spring College on Plasma Physics at the International Centre for Theoretical Physics, Trieste, Italy, 1987. The lecture aims to present a restricted number of results of a few major studies performed on JET in the period mid 1983 to the end of 1986. The studies concern impurities in the plasma, density limit and disruptions, and energy confinement. Various developments planned for the future operation of JET are also outlined. (U.K.).

38770 (JET-R—87-13) Inquiry on nuclear fusion for peaceful uses by the 12th Committee of Industry of the Italian Parliament. Statement presented by Enzo Bertolini on 18th December 1986. Bertolini, E. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753517/JAW.

The paper is a statement by the author to the 12th Committee of Industry of the Italian Parliament concerning the Inquiry on nuclear fusion for peaceful uses. The basis concepts of thermonuclear fusion are outlined. A description is given of the European Programme, and the role of the JET Project within that Programme. The role of the JET Project in the field of fusion research is described, in detail. Preliminary answers to the Committee's questions on fusion posed previously are also reported. (U.K.).

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REFER ALSO TO CITATION(S) 38267, 38323, 38337, 38455, 38859, 38881, 38938, 39038

38771 (ANL/FPP/TM—221) Bootstrap currents in radio-frequency-driven tokamak equilibria. Hsiao, Ming-Yuan; Ehst, D.A.; Evans, K. Jr. (Argonne National Lab., IL (USA). Fusion Power Program). May 1988. Contract W-31109-ENG-38. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011136/JAW.

Interest in the bootstrap current arising from neoclassical transport in tokamaks has increased recently in view of certain experimental observations. In this study, the bootstrap current is calculated for a number of rf current-driven tokamaks. Two-dimensional, self-consistent, steady-state tokamak MHD equilibria are obtained by including both the transport-driven bootstrap current and the externally driven rf current. The self-consistency is acomplished by iterating between two-dimensional MHD equilibrium calculations and the current calculations (including bootstrap and rf ray-tracing). Calculations for other reactor parameters of interest are also carried out. It is found that for reactor-grade plasmas, the bootstrap current contribution to the toroidal current is, in general, important. An approxiamte scaling law for Γ, based on parametric survey performed, is also obtained. 16 refs., 8 figs., 1 tab.

38772 (CEA-CONF—9182) Energy balance and transient responses in wave driven plasmas. Rax, J.M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Jun 1987. 5p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752556/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

In a current-drive experiment with a RF power source, a certain amount of power is absorbed by resonant electrons. From the electrons, energy can flow through four channels: it can be converted into magnetic work when the electron interacts with an electric field, or it can be converted into heat when the electron collides the thermal plasma. In addition, there exists also the conversion of the low frequency RF energy into high frequency non thermal free-free or cyclotron radiation. Efficiencies of these conversions are considered together with the turn-on times of the associated responses.

38773 (CEA-CONF—9183) Potentiality of fast wave current drive in non-Maxwellian plasmas. Moreau, D.; O'Brien, M.R.; Cox, M.; Start, D.F.H. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Jun 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752557/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

After a short analysis of the available experimental data on pure fast wave electron current drive we propose a theoretical scaling law for the wave absorption through combined electron Landau damping and transit time magnetic pumping. We then present the result of a fully relativistic calculation which we apply to a bi-Maxwellian electron distribution function and conclude on the requirements to be fulfilled by the energetic tail for obtaining significant damping in Tore-Supra.

38774 (CEA-CONF—9195) Effect of magnetized collisions on classical and neociassical transport. Ghendrih, P.; Samain, A.; Misguich, J.H. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753452/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

In current tokamak experiments the electron Larmor radius rho/sub e/ is of the order or smaller than the Debye screening length λ/sub D/. Therefore the Larmor trajectories should lead to significant changes of the collision contribution to the transport coefficients. These changes can be understood as the balance between two opposite effects, with on one hand an enhancement due to increased interaction times (confinement effect) and on the other hand an inhibition of transverse exchanges since the magnetic momentum is constant for magnetized collisions (the interaction scale is larger than the Larmor radius. As a consequence a precise and detailed study is necessary to obtain the exact magnetic dependence induced by the Larmor trajectories effects.

38775 (CIEMAT—610) Study of TJ-1 Tokamak plasmas with Thomson scattering and radiation diagnostics. Pardo, C.; Zurro, B. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). Jun 1987. 166p. (In Spanish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702841/JAW.

The Thomson scattering system of TJ-1 is described in detail. The radial profiles of T/sub e/ and n/sub e/ óbtained in TJ-1 discharges are presented. This data makes possible to deduce characteristic parameters of the plasma confinement in this machine, as energy confinement times, Z/sub eff/ B. Using also radiation measurements (global and in the visible range) we obtained the particle confinement time and Z/sub eff/ without non experimental assumptions. (author) 56 figs., 52 refs.

38776 (CONF-880363—3) Linear ideal MHD stability calculations for ITER. Hogan, J.T. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 116p. NTIS, PC A06. Order Number DE88011012/JAW.

From Fusion Energy Division information meeting; Oak Ridge, TN, USA (9 Mar 1988).

A survey of MHD stability limits has been made to address issues arising from the MHD--poloidal field design task of the US ITER project. This is a summary report on the results obtained to date. The study evaluates the dependence of ballooning, Mercier and low-n ideal linear MHD stability on key system parameters to estimate overall MHD constraints for ITER. 17 refs., 27 figs.

38777 (CONF-880398—1-Vugraphs) Detailed modeling of spectroscopic data: Modeling support for ORNL PMI WORK: TEXTORALT-II, TORE SUPRA, ATF. Hogan, J.; Klepper, C.; Hillis, D.; Uckan, T. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 32p. NTIS, PC A03;3. Order Number DE88009701/JAW.

From US-Japan workshop on limiter and divertor tokamaks; Los Angelos, CA, USA (21 Mar 1988).

This paper contains vugraphs on particle source effects on confinement time scaling. Detailed modeling of H/sub α/ intensity spatial distribution is discussed. (LSP)

38778 (CONF-880512—3) Modeling of spectroscopic measurements of edge recycling. Hogan, J.; Klepper, C.; Hillis, D.; Uckan, T. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 26p. NTIS, PC A03;3. Order Number DE88010135/JAW.

From 8. international conference on plasma surface interactions in controlled fusion devices; Julich, F.R. Germany (2 May 1988).

The study of confinement scaling with plasma parameters requires, in general, modeling of the input sources of particles and energy. We investigate modeling issues important for understanding the scaling of particle confinement with density; a scaling which depends on knowledge of the variation of the fuelling profile. By detailed fitting of the poloidal variation of H/sub α/ light from a density scaling sequence of TEXT discharges at fixed B/sub T/ and I/sub p/, we are able to calculate the variation in mean ionisation radius as density is varied for a typical scaling sequence. Variation of several free parameters are required for calculations such as this, so we have examined the feasibility of reducing the number of parameters by modeling velocity-space resolved data. Three dimensional Monte Carlo calculations of the H{sub{alpha}} lineshape are presented, including Doppler broadening and Zeeman splitting effects. Many important confinement studies are conducted in 'carbonised' devices. We have studied the problem of determining the fuelling profile in carbon-rich plasmas by calculating the H_α deposi-

tion due to CH_4 breakup, and by carrying out experiments in the ORNL Plasma Materials Interaction Test Facility to measure the H/sub α/ lineshape in discharges with CH_4 injection into pure D_2 plasmas.

38779 (CONF-880512—4) Experimental investigation of the natural divertor configuration in Heliotron-E. Hillis, D.L.; Mioduszewski, P.K.; Fowler, R.H.; Rome, J.A.; Motojima, O.; Mizuuchi, T.; Noda, N.; Mutoh, T.; Zushi, H.; Takahashi, R.; Obiki, T.; Iiyoshi, A.; Uo, K. (Oak Ridge National Lab., TN (USA); Kyoto Univ., Uji (Japan). Plasma Physics Lab.). 1988. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010444/JAW.

From 8. international conference on plasma surface interactions in controlled fusion devices; Julich, F.R. Germany (2 May 1988).

Particle control with pump limiters and divertors has been successfully demonstrated in a number of present-day tokamaks. In a heliotron/stellarator configuration, plasma flows to the wall in distinct flux bundles, often called "divertor stripes". This complicated three-dimensional characteristic of the plasma edge presents a new challenge for active particle control systems such as pump limiters and divertors. The experiment described here has obtained data with an instrumented pump particle collector that is located in the "natural" magnetic divertor stripe of Heliotron-E. The particle collector consists of a moveable graphite assembly with single-sided particle collection and active pumping. By scanning the particle collector assembly through the plasma edge of Heliotron-E, the divertor stripe is observed to be about 2-3 cm (FWHM) in width, and pressure rises of 0.01-0.01 mTorr are observed in the particle collector pumping chamber. These measurements have demonstrated that particles leaving the bulk plasma via the divertor stripes can be collected and provide a basis for developing a divertor scheme for particle control in helical systems. Modelling of the Heliotron-E magnetic configuration at the plasma edge is used to determine the collection efficiency of the particle collector in the divertor stripes. The modeling is further extended to describe a helical divertor concept. 18 refs., 6 figs.

38780 (CONF-880534—5) Current drive and heating systems based on high-energy (1- to 3-MeV) negative ion beams. Becraft, W.R.; Akerman, M.A.; Haselton, H.H.; Murphy, B.D.; Lousteau, D.C.; Ryan, P.M.; Whealton, J.H.; McMichael, G.E.; Schempp, A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010128/JAW.

From 15. European conference on controlled fusion and plasma heating; Dubrovnik, Yugoslavia (16 May 1988).

This paper describes a concept for a current drive system based on negative ions with beam energy > 1 MeV. Preliminary physics calculations show that the core current necessary for stability enhancement can best be achieved by beams with energy ranging from 1 to 4 MeV. Further study and experiments will better define the optimum energy. Work under way at Oak Ridge National Laboratory (ORNL) and at collaborating institutes in Canada and the Federal Republic of Germany is defining a system, its elements, a configuration and operational scenarios deemed appropriate for such devices as ITER and other future steady-state tokamaks, and the requisite research and development to provide such a system. 7 refs., 2 figs.

38781 (CONF-8804103—2-Vugraphs) Ideal low-n and Mercier mode stability boundaries for $1 = 2$ torsatrons. Dominguez, N.; Leboeuf, J.N.; Carreras, B.A.; Lynch, V.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009872/JAW.

From Sherwood theory conference; Gatlinburg, TN, USA (18 Apr 1988).

We have studied the relationship between the stability properties of ideal low-n internal modes and the 3-D ideal Mercier criterion for $1 = 2$ torsatron configurations. For the low-n stability studies, the stellarator expansion has been used as implemented in the FAR code. The 3-D Mercier criterion has been applied to the equilibria calculated with the VMEC code. This investigation has been carried out for several torsatron configurations, exploring a broad range of aspect ratios, and different pressure profiles. We find that: 1) the low-n modes with singular surfaces lying in a Mercier region are in general unstable, and 2) the critical β given by the Mercier criterion agrees well with the critical β for the lowest n unstable mode. This is verified even in the case of global $n = 1$ modes. Therefore, the 3-D Mercier criterion is a useful guide in mapping the ideal stability β limits for these torsatron configurations. 12 figs.

38782 (CONF-8804103—3-Vugraphs) Full-wave calculations in flux coordinates for toroidal geometry. Carreras, B.A.; Lynch, V.E.; Jaeger, E.F.; Batchelor, D.B. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010131/JAW.

From Sherwood theory conference; Gatlinburg, TN, USA (18 Apr 1988).

A new 2-D full-wave code, HYPERION, employing a poloidal and toroidal mode expansion and including the toroidal terms arising in the wave equation has been developed. It is based on the existing modules developed for the MHD stability codes and uses as input the tokamak equilibria calculated with the RSTEQ code. At present the plasma response is described by the collisionally broadened cold plasma conductivity. However, the code is written in straight field line coordinates, this permits the accurate representation of k /sub {parallel/} and as a consequence allows the incorporation of the plasma Z functions. This code also retains the E/ sub {parallel/} component of the electric field which will allow the study of the low density region of the plasma. We have done detailed benchmarking of the HYPERION code in the cold plasma limit with the existing finite difference ORION full-wave code. The agreement is very good.

38783 (CTH-IEFT/PP—1987-03) Solutions of reaction-diffusion integral equations describing explosive evolution of densities for localized structures. Wilhelmsson, H. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752488/JAW.

Reaction-diffusion integral equations are studied with special regard to explosive-type solutions. Certain localized structures can grow explosively in time without change in spatial structure. The characteristic shapes can be described in terms of elliptic functions.

38784 (DOE/ER/13787—T1) Investigation of parameters critical to muon-catalyzed fusion: Research continuation proposal. Jones, S.E.; Palmer, E.P.; Rees, L.W.; Li, Ping; Sheely, E.; Shurtleff, K.; Taylor, S.; Thorne, J.M.; Anderson, A.N. (Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy; Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry; Idaho Research, Inc., Idaho Falls (USA)). 10 May 1988. Contract FG02-87ER13787. 14p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010959/JAW.

We have demonstrated (in conjunction with our colleagues) that muon catalysis cycling rates increase rapidly with increasing deuterium-tritium gas temperatures and densities. Furthermore, muon-capture losses are significantly smaller than predicted before the experiments began, although recent theoretical work narrows the gap between theory and observation. As a result of these effects, we have been able to achieve muon-catalyzed fusion yields of 150 fusions/muon (average). The fusion energy thereby released, nearly 3 GeV/muon, significantly exceeds theoretical expectations, and still higher yields are expected. New theoretical predictions of higher fusion yields in low-temperature plasmas and d-t gases with large applied magnetic fields stimulate further investigation. We are exploring the limits of muon-catalyzed fusion, to provide answers to questions regarding energy applications of muon-catalyzed fusion. 13 refs., 3 figs.

38785 (DOE/ER/52147—1) Free electron lasers with small period wigglers: Progress report for the period September 15, 1987 to September 14, 1988. Granatstein, V. L.; Antonsen, T. M. Jr.; Booske, J. H.; Destler, W. W.; Mayergoyz, I. D.; Ott, E. (Maryland Univ., College Park (USA)). Jun 1988. Contract FG05-87ER52147. 38p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011627/JAW.

The focus of the overall program is to develop short period wiggler (SPW) free electron lasers (FELS) as an alternate source of high-average-power millimeter wave radiation for electron cyclotron resonance heating (ECRH) in advanced magnetic fusion experiments such as the Compact Ignition Torus. Research progress to date is summarized with details described. So far, all of our studies have provided evidence which supports the feasibility of the SPW FEL concept. This includes investigations of sheet beam propagation and stability, thermal stability of the rf cavity under CW operation, and nonlinear evolution of {endash} and competition between {endash} multiple aixal modes. The eventual goal of our program is to develop a 1.0 MW, CW-compatible SPW FEL operating near one millimeter wavelength. The near term goals are to demonstrate proof-of-principle in a pulsed system (1.5 μs pulse length) and to identify solutions to additional problems that a long pulse (i.e., 3 sec) or CW system might encounter. A new two year research program is proposed beginning in September 1988. The culmination of this program will be the proof-of-principle experiment, which we propose will commence operation in the beginning of calendar year 1990.

38786 (DOE/ER/53202—T5) Theoretical studies of controlled fusion: Final report. Krall, N.A. (JAYCOR, San Diego, CA (USA)). 31 Jul 1987. Contract FG03-85ER53202. 15p. (J—530-87-737/2442). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010235/JAW.

This report summarizes the results of a study of low frequency stability in the Field Reversed Configuration (FRC), with emphasis on the transport resulting from this stability behavior. 11 refs., 5 figs., 2 tabs.

38787 (DOE/ER/53212—121) Reminimization of energy integral and stability limit for non-ideal MHD (magnetohydrodynamic) plasma. Kondoh, Y. (Wisconsin Univ., Madison (USA). Dept. of Physics). Mar 1988. Contract FG02-85ER53212. 24p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008422/JAW.

The stability condition of relaxed states is derived from the energy principle for the non-ideal MHD plasma. An Euler equation for the reminimization of energy integral is derived and shown to give the marginal stable, non-singular perturbations for the stability condition. An extended stability limit for the $\beta = 0$ relaxed states is derived from the stability condition, with use of the eigenvalue analysis for the Euler equation. By using the perturbation method, the extended stability limit is solved in the 1st order approximation to explain the deviation of the experimental stability limit from the idealized stability limit by Taylor. A procedure to get overall stability limit against both the non-singular and the singular perturbations is discussed. 25 refs.

38788 (DOE/ER/53218—120) Numerical simulations of resistive magnetohydrodynamic instabilities in a poloidal divertor tokamak. Uchimoto, E. (Wisconsin Univ., Madison (USA)). Mar 1988. Contract FG02-86ER53218. 109p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010768/JAW.

A new 3-D resistive MHD initial value code RPD has been successfully developed from scratch to study the linear and nonlinear evolution of long wavelength resistive MHD instabilities in a square cross-section tokamak with or without a poloidal divertor. The code numerically advances the full set of compressible resistive MHD equations in a toroidal geometry, with an important option of permitting the divertor separatrix and the region outside it to be in the computational domain. A severe temporal step size restriction for numerical stability imposed by the fast compressional waves was removed by developing and implementing a new, efficient semi-implicit scheme extending one first proposed by Harned and Kerner. As a result, the code typically runs faster than that with a mostly explicit scheme by a factor of about the aspect ratio. The equilibrium input for RPD is generated by a new 2-D code EQPD that is based on the Chodura-Schluter method. The RPD code, as well as the new semi-implicit scheme, has passed very extensive numerical tests in both divertor and divertorless geometries. Linear and nonlinear simulations in a divertorless geometry have reproduced the standard, previously known results. In a geometry with a four-node divertor the m = 2,n = 1 (2/1) tearing mode tends to be linearly stabilized as the q = 2 surface approaches the divertor separatrix. However, the m = 1,n = 1 (1/1) resistive kink mode remains relatively unaffected by the nearness of the q = 1 surface to the divertor separatrix. When plasma current is added to the region outside the divertor separatrix, the 2/1 tearing mode is linearly stabilized not by this current, but by the profile modifications induced near the q = 2 surface and the divertor separatrix. A similar stabilization effect is seen for the 1/1 resistive kink mode, but to a lesser extent. 77 refs., 91 figs.

38789 (DOE/ER/53227—119) Tokamak magnetic turbulence over the safety factor range $0.6 < q < 3$. Graessle, D.E.; Prager, S.C.; Dexter, R.N. (Wisconsin Univ., Madison (USA). Dept. of Physics). Mar 1988. Contract FG02-86ER53227. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008421/JAW.

Magnetic turbulence (ν<400kHz) has been measured both internal and external to a tokamak plasma as the edge q is varied from 0.6 to 3. The radial and poloidal spatial dependence fo the coherence is investigated. The spatial and frequency dependence of the fluctuations are similar over the wide range of q. 10 refs., 7 figs.

38790 (DOE/ET—53088-312) Drift wave vortices and anomalous transport. Horton, W. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Apr 1988. Contract FG05-80ET53088. 40p. (IFSR—312). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009562/JAW.

Theory and computer simulations are used to describe the inelastic vortex-vortex and vortex-wave interactions that lead to the quasi-coherent transport of plasma across the magnetic field. Monopole and dipole drift wave vortices with radii r_0 large compared with the ion inertial scale length {rho}/sub s/ are shown to produce transport at the rate un/sub v/$\int d\sigma(b) \leq$ n/sub v/v/sub de/τ/sub o/ where n/sub v/ is the vortex line density and $d\sigma(b)$ is the inelastic collision cross-section for impact parameter b. The transport during collisions and mergings is evaluated from the evolution of a passively convected scalar concentration of test particles. 24 refs., 4 figs.

38791 (DOE/ET/53059—T1) Multiple mirror experiment (MMX): Final report, November 15, 1973-March 24, 1986. Lichtenberg, A.J.; Lieberman, M.A. (California Univ., Berkeley (USA). Electronics Research Lab.). Feb 1987. Contract AS03-76ET53059. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008141/JAW.

This paper briefly discusses the accomplishments and developments on the multiple mirror confinement device. (LSP)

38792 (ENEA-RT-FUS—87-22, pp 25-30) Propagation of LH waves in plasma in presence of M=1.2 magnetic island. Romanelli, F.; Cardinali, A.; Bartiromo, R. (ENEA, Frascati (Italy). Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701801/JAW. (CONF-8708235—).

From International school of plasma physics; Varenna, Italy (24 Aug 1987).

The effect of magnetic islands on the propagation of lower hybrid waves is investigated by using a recently developed asymptotic technique which allows explicit analytical solutions of the problem. Near the mode rational surface the model equilibrium is a slab with a single helicity perturbation corresponding to a m=1 or m=2 island. Particular attention is focused on the deformation of the wave trajectory and on the variation of the parallel component of the wavevector inside the island which can affect tha local absorption of the wave.

38793 (ENEA-RT-FUS—87-22, pp 5-23) **Microinstability based models of anomalous energy transport.** Romanelli, F. (ENEA, Frascati (Italy). Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701801/JAW. (CONF-8708235—).

From International school of plasma physics; Varenna, Italy (24 Aug 1987).

A model is presented for the anomalous transport which relies on the effect of the semicollisional microinstabilities driven by the trapped electron dynamics and by the combined effect of temperature gradients and curvature. Upon using the results of a general stability analysis of such modes, the quasilinear transport coefficients are derived and compared to the general trends in transport. In particular, when used in steady-state transport codes the model correctly reproduces the results of ohmic experiments. The role of strongly collisional microinstabilities in affecting the edge transport is also discussed. 36 refs.

38794 (ENEA-RT-FUS—87-22, pp 31-34) **Density fluctuation in Tokamaks. A phenomenological approach.** Ottaviani, M. (ENEA, Frascati (Italy). Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701801/JAW. (CONF-8708235—).

From International school of plasma physics; Varenna, Italy (24 Aug 1987).

Explaining the features of turbulent fluctuation spectra from fundamental theory is a very difficult task at present. Linear theory is useful when the instability sets in, but present experiments are not designed to investigate the transition to turbulence, but simply to study the properties of the turbulent state itself. Therefore, it is generally difficult to state which instabilities are responsible of the observed state. More over the theory of saturated turbulence seems itself not enough developped to give quantitative answers. In this work a phenomenological approach is pointed out. An attempt is to describe fluctuations around the observed (average) state by means of some equation for the fluctuating part of the density n(r,t). More precisely, essentially the power law behavior of correlation functions at large frequency and wavenumber is considered.

38795 **(EUR-CEA-FC—1314) Gravitational interchange instability when g.nablarhoo=0: part 1.** Paris, R.B. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Sep 1987. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753482/JAW.

The analogue of the Rayleigh-Taylor instability (gravitational interchange mode) for an infinitely conducting, approximately one-dimensional plane plasma slab is examined when the gravitational acceleration g is supposed to be perpendicular to the equilibrium density gradient nablarhoo. It is found that, in contrast with the classical situation (where g is aligned with nablarhoo). Furthermore, for a current layer with magnetic shear, the mode is unstable for all values of nablarhoo: there is no instability threshold equivalent to the Suydam criterion for the classical gravitational interchange mode. The characteristic growth rate of the instability is given by $\omega/\mathrm{sub}\ G/\sqrt{2}$, where $\omega/\mathrm{sub}\ G/ \simeq (gnablarhoo)^{1}2$ denotes the characteristic growth rate of the Rayleigh-Taylor instability, together with a small oscillatory frequency.

38796 **(EUR-CEA-FC—1333) Fast ion ripple losses during neutral injection in TFR.** Tuszewski, M.; Roubin, J.P. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Dec 1987. 65p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753483/JAW.

Fast ion ripple losses during neutral beam injection in TFR are measured near-quantitatively with an array of Faraday collectors mounted between two toroidal field coils. The collected currents show multiple evidence for fast ion ripple losses and correspond to global losses of 30-40% of the injected current. The measurements are complemented by a simple Fokker-Planck model, itself checked against Monte-Carlo simulations on several cases. These calculations clarify many experimental features but predict only about half of the observed ripple-lost current. This discrepancy could be due in part to various experimental and theoretical uncertainties although there are indications of some enhanced ripple losses in the experiments. Such losses could arise from other processes than toroidal field ripple not included in the calculations, and may suggest along with other diagnostics an enhanced depletion of central fast ions, the origin of which remains unclear. Fast ion ripple losses are calculated and observed to be fairly insensitive to factors of 2 variations in most plasma parameters. Substantial losses are predicted only when injecting near-perpendicular into a Tokamak plasma of edge $\geqq 1\%$.

38797 **(GA-A—19185) The DIII-D E{parallel}B charge exchange diagnostic.** Heidbrink, W.W. (General Atomics Co., San Diego, CA (USA)). Feb 1988. Contract AC03-84ER51044. 14p. (CONF-880364—25). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010830/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

One of the neutral-particle spectrometers used on the Doublet III tokamak has been improved and modified for use as an active charge exchange diagnostic on the DIII-D tokamak. The spectrometer employs a He stripping cell, parallel {rvec E} and {rvec B} analyzer fields, and a microchannel plate detector sixty energy channels for each of two neutral particle masses. Improvements to the diagnostic include better radio frequency and gamma ray and complete instrumentation of all energy channels. Calibration results for H and D are similar to those reported previously. The instrument views across one of the DIII-D heating beams which can be modulated to provide local neutral doping. The analyzer is scanned shot-shot to measure neutrals with pitch angles between {approximately}5{degree} and {approximately}110{degree}. 34 refs., 5 figs.

38798 **(GA-A—19204) H-mode study in DIII-D.** Ohyabu, N.; Allen, S.; Brooks, N.H.; Bramson, G.; Burrell, K.H.; Callis, R.W.; Carlstrom, T.N.; Colleraine, A.P.; Content, D.; DeBoo, J.C.; Gohil, P.; Groebner, R.J.; Howl, W.; Hill, D.N.; Hong, R.M. (General Atomic Co., San Diego, CA (USA)). Mar 1988. Contract AC03-84ER51044. 11p. (CONF-880534—8). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011664/JAW.

From 15. European conference on controlled fusion and plasma heating; Dubrovnik, Yugoslavia (16 May 1988).

H-mode has been observed in DIII-D single null divertor discharges. Many observed features are similar to those of other devices. In this paper, we discuss new and detailed experimental findings mostly from DIII-D beam heated discharges. The H-mode transition requires a minimum input power and a minimum density. These minimum values depend on various plasma parameters. The detailed parametric dependence has not yet been established. However, H-mode accessibility is easiest for low B/sub T/, D-plasma with ion {gradient}B drift toward X-point. Under such conditions, the H-transition is achieved with low power (0.8 MW) ECH alone. Furthermore, a temporary H-mode phase, lasting {approximately}30 msec is triggered by a sawtooth crash in purely ohmically-heated, low q discharges. After the transition, the density profile becomes flat with a very steep edge gradient within several msec and further develops into a hollow profile. The average density continuously increases during entire H-phase until an Edge Localized Mode (ELM) occurs. On the other hand, the edge electron temperature rises rapidly from 200 eV to 350 eV within {approximately}50 msec after the transition and then saturates. 9 refs., 4 figs.

38799 **(GA-A—19218) MHD stability in high β/sub {Tau/} DIII-D divertor discharges.** Lao, L.L.; Strait, E.J.; Taylor, T.S.; Chu, M.S.; Burrell, K.H.; DeBoo, J.C.; Gohil, P.; Groebner, R.J.; Hsieh, C.L.; Howl, W.; Kellman, A.G.; Osborne, T.H.; Ozeki, T.; Stambaugh, R.D.; St. John, H.; Turnbull, A.D. (General Atomics Co., San Diego, CA (USA); Japan Atomic Energy Research Inst., Tokyo). Mar 1988. Contract AC03-84ER51044. 6p. (CONF-880534—7). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010587/JAW.

From 15. European conference on controlled fusion and plasma heating; Dubrovnik, Yugoslavia (16 May 1988).

Doublet III-D has achieved a β/sub {Tau/} of over 6% in H-mode divertor plasmas and has not exceeded the beta limit as allowed by ideal MHD instabilities. Experimental results of this test run are summarized. 4 refs., 4 figs. (DWL)

38800 (GA-A—19306) High β and ECRH studies in DIII-D. Stambaugh, R.; Allen, S.; Bramson, G.; Brooks, N.; Burrell, K.H.; Callis, R.; Carlstrom, T.; Chance, M.; Chu, M.; Colleraine, A. (Lawrence Livermore National Lab., CA (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.; Johns Hopkins Univ., Baltimore, MD (USA); Hitachi Ltd., Tokyo (Japan); Commission of the European Communities, Abingdon (UK). JET Joint Undertaking; Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). May 1988. Contract AC03-84ER51044;W-7405-ENG-48. 14p. (CONF-880534—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011911/JAW.

From 15. European conference on controlled fusion and plasma heating; Dubrovnik, Yugoslavia (16 May 1988).

The DIII-D high and low beta stability results have established the basic feasibility of the divertor and H-mode configurations up to elongation 2.0 for next generation tokamaks. The 6.8% β/sub T/ achieved has already exceeded projected operating requirements of next generation devices. β/sub T/ $>$ 6% has been sustained for 800 ms. Stability calculations and patterns of MHD mode behavior suggest a central expanding zone of ballooning instabilities leads ultimately to unstable m/n = 2/1 modes which cause beta collapse or disruption. The pressure gradient at the plasma edge just reaches the first regime ballooning limit prior to ELMs. ECRH has proven effective for generating H-mode, sawtooth suppression, and ELM suppression.

38801 (INFN/TC—88-1) High power CW electron beam for FEL devices. Boscolo, I.; Ciocci, F.; Dattoli, G. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702278/JAW.

Electrostatic accelerators suitable for CW millimeter fir high power FEL are analyzed. The laser performances with main emphasis to the efficency and power output are also discussed. 28 refs.

38802 (IPP—III/130) Heating and confinement in the ion cyclotron range of frequencies on the divertor tokamak ASDEX. Steinmetz, K.; Niedermeyer, H.; Noterdaeme, J.M.; Wesner, F.; Wagner, F.; Baeumler, J.; Becker, G.; Becker, W.; Bosch, H.S.; Brambilla, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Stuttgart Univ. (Germany, F.R.); AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.; Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria; Washington Univ., Seattle (USA)). Jan 1988. 58p. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.).

A summary of the experiments performed with ion cyclotron heating on ASDEX from November 1984 until March 1986 is given, and the most interesting results are reported and discussed in detail. Heating and confinement studies in the hydrogen second harmonic and hydrogen minority schemes (P/sub IC/ $<$ 2.6 MW, t/sub IC/ $<$ 1.5 sec) reveal a typical L-mode behaviour, i.e. a power dependent confinement degradation, which is rather similar to that found with neutral beam injection heating. ICRH is accompanied with a slightly improved particle and energy continement compared to NI, which still holds when ICRH and NI are combined up to P/sub tot/ $\simeq$ 4.5 MW absorbed in the plasma. Particular efforts have been devoted to investigations of the second harmonic regime in HD mixture plasmas of n/sub H/nϵ $\simeq$ 0.1 to 1 which turns out to exhibit a high heating potential under reactor relevant plasma conditions. The achievement of H-mode transitions with ICRH alone in the hydrogen minority scheme at an absorbed RF power of about 1.1 MW supports the indications of a unique confinement structure with auxiliary heating in tokamaks which appears to be widely independent of the additional heating method. ICRH-specific impurity problems such as the strong release of iron from the vessel walls have been overcome by applying extensive in-situ wall carbonisation. The mechanisms responsible for the impurity generation have partly been identified and analyzed, however, the problem still remains to be solved. Impurities preferentially released from the ICRH antenna do not pose a problem. With 65 refs..

38803 (IVO-A—06/87) Plasma technology. Preliminary studies 2. Bergring, C.; Sivusaari, T.; Jeskanen, R.; Halonen, A.; Saikkonen, J. (Imatran Voima Oy, Helsinki (Finland)). 1987. 108p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752815/JAW.

The report includes four preliminary studies based on literature and one preliminary study based on tests. 1. Raising and maintaining the temperature of the ladle and the melt using plasma 2. The use of plasma technology in cupolas 3. Raising the temperature of the blast furnace blast using plasma 4. The use of plasma technology in drying 5. Cleaning up hazardous waste using plasma technology. Study No. 1 deals with the applicability of plasma technology to raising and maintaining the temperature of the ladle. This technique improves the earlier methods but the equipment is still expensive. Study No. 2 deals with the ways of cutting production costs in cupolas using plasma technology. The process is best suited for the smelting of fine raw material and for increasing the smelting capacity. Study No. 3 deals with the effects of raising the blast furnace blast temperature on the properties and economy of the process. The use of electricity to only replace energy received from coke is uneconomical but it also has other advantages. Study No. 4 considers the applicability of air and steam plasma to the drying of pulp, and its economy. At the present price of electricity the process is uneconomical. Study No. 5 describes tests on decomposing liquid organic substances using plasma. The process is still being developed, and seems promising.

38804 (KFTI—87-37) Apparatus for submillimeter laser diagnostics of high-temperature plasma. Berezhnyj, V.L.; Kononenko, V.I.; Pavlichenko, O.S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 33p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702464/JAW.

Constructions and characteristics of an HCN laser with RF discharge (RFD) and a CH_3OH laser pumped with a CO_2 laser radiation are presented. Scaling laws simplifying the RFD HCN design calculations with the given parameters are found. The CH_3OH-laser frequency-response curve, that essentially determines the main heterodyne laser interferometer characteristics, is investigated. Owing to high stability of the output power and frequency the present lasers can be used in heterodyne interferometers. The design and parameters of a low temperature submillimeter radiation detectors on the basis of InSb and GeLi crystals are described. The results of interferometer measurements at plasma devices by means of the given apparatus are presented. 26 refs.; 22 figs.; 2 tabs.

38805 (LA—11178-MS) Introduction to laser plasma diagnostics. Hauer, A.A.; Baldis, H.A. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 45p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011056/JAW.

This report reviews optical and x-ray techniques for the diagnosis of laser-produced plasmas. Emphasis is placed on the parameter regimes (e.g., laser irradiance $> 10^{12}$ wattscm^2) appropriate to the laser fusion field. We also include, however, material related to other laser-plasma work such as chemical analysis. We intend this work to be an introduction to the basic physical principles involved in measurements. We also deal with the comparison of these measurements with modeling. A considerable number of specific examples of measurements are presented to illustrate the techniques described. 132 refs., 29 figs., 2 tabs.

38806 (LA-UR—88-1698) Monte Carlo alpha deposition. Talley, T.L.; Evans, F. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 4p. (CONF-880546—8). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010913/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

Prior work demonstrated the importance of nuclear scattering to fusion product energy deposition in hot plasmas. This suggests careful examination of nuclear physics details in burning plasma simulations. An existing Monte Carlo fast ion transport code is being expanded to be a test bed for this examination. An initial extension, the energy deposition of fast alpha particles in a hot deuterium plasma, is reported. The deposition times and deposition ranges are modified by allowing nuclear scattering. Up to 10% of the initial alpha particle energy is carried to greater ranges and times by the more mobile recoil deuterons. 4 refs., 5 figs., 2 tabs.

38807 **(PPPL—2489) Particle diffusion in a spheromak.** Meyerhofer, D.D.; Levinton, F.M.; Yamada, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1988. Contract AC02-76CH03073. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009350/JAW.

The local carbon particle diffusion coefficient was measured in the Proto S-1/C spheromak using a test particle injection scheme. When the plasma was not in a force-free Taylor state, and when there were pressure gradients in the plasma, the particle diffusion was five times that predicted by Bohm and was consistent with collisional drift wave diffusion. The diffusion appears to be driven by correlations of the fluctuating electric field and density. During the decay phase of the discharge when the plasma was in the Taylor state, the diffusion coefficient of the carbon was classical. 23 refs., 4 figs.

38808 **(PPPL—2490) Ion temperature by charge exchange neutral analysis from vertical sightlines on the Tokamak Fusion Test Reactor.** Fiore, C.L.; Medley, S.S.; Hammett, G.W.; Kaita, R.; Scott, S.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1987. Contract AC02-76CH03073. 29p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009351/JAW.

The Fokker-Planck code FPPRF is used to calculate the expected deuterium charge exchange flux along vertical sighlines from TFTR neutral-beam-injected discharges. The feasibility of obtaining central ion temperature measurements by fitting the spectra obtained from these sightlines at two energy regions--above the highest neutral beam injection energy (> 100 keV) and from 20-80 keV--is investigated. It is demonstrated that the central ion temperature can be obtained from the central vertical slightline for fitting the high energy data. The deuterium neutral particle flux energy distribution below the neutral beam injection energy is insentive to the code input ion temperature, however. 6 refs., 12 figs., 1 tab.

38809 **(PPPL—2493) Mode particle resonances during near-tangential neutral beam injection in large tokamaks.** Kaita, R.; White, R.B.; Morris, A.W.; Fredrickson, E.D.; McGuire, K.M.; Medley, S.S.; Scott, S.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1988. Contract AC02-76CH03073. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009354/JAW.

Coherent magnetohydrodynamic modes have been observed during neutral beam injection in TFTR and JET. Periodic bursts of oscillations were detected with several plasma diagnostics, and Fokker-Planck calculations show that the populations of trapped particles in both tokamaks are sufficient to account for fishbone destabilization. Estimates of mode parameters are in reasonable agreement with the experiments, and they indicate that the fishbone mode may continve to affect the performance of intensely heated tokamaks. 13 refs., 1 fig., 1 tab.

38810 **(PPPL—2495) A dual far-infrared laser diagnostic of magnetized plasmas.** Darrow, D.S.; Park, H.K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1988. Contract AC02-76CH03073. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009355/JAW.

A dual far-infrared laser has been constructed and its properties have been exploited to probe tokamak-like discharges in the CDX toroidal device. Thermal variation of the difference frequency between the two far-infrared cavities is slow, though the cavities lack thermal stabilization, simply because their assembly on the same chassis exposes them to virtually identical temperature changes. The optical arrangement beyond the laser permits conversion within minutes between interferometry and density fluctuation observation, and within an hour between different operating wavelengths. Line-average densities of 2 {times} 10^{13} cm^{-3} and coherent fluctuations in the neighborhood of 20 kHz have been measured with this diagnostic. 15 refs., 5 figs., 2 tabs.

38811 **(PPPL—2497) q-dependent, H-mode-like phenomena in TFTR.** Budny, R.; Bell, M.; Bitter, M.; Bush, C.; Dylla, H.F.; Fredrickson, E.; Goldston, R.; Hendel, H.; Hill, K.; Hsuan, H.; Kilpatrick, S.; McCune, D.; McGuire, K.; Medley, S.S.; Morris, W.; Park, H.; Ramsey, A.; Scott, S.; Stratton, B.; Taylor, G.; Ulrickson, M.; Zarnstorff, M.C.; Zweben, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1988. Contract AC02-76CH03073. 22p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009357/JAW.

A new phenomenon has been observed in TFTR discharges with neutral beam injection and slowly ramped plasma current. When q/sub {psi/} (a) reaches certain values close to low-order rational numbers, the D/sub α/ emission decreases and the electron density profile broadens and increases, similar to observations during the H-mode in other tokamaks. This "q-mode" appears to have a neutral beam power threshold of {approximately} 6 MW. During co-injection, the plasma toroidal rotation decreases by {approximately} 50% at the transition. Very slowly toroidally rotating coherent adge modes, which slow and lock at the transition, were identified from the measured perturbations in {tilde B}/sub theta/} with mn {approximately} q/sub {psi/}(a). Calculations based on a tearing-mode model indicate that large islands, consistent with these measurements, could be present in the plasma edge and alter the plasma limiter interaction. At the transition Z/sub eff/ increases typically from 3 to 3.5. This increase and the electron density increase are caused largely by an increase in the carbon density. These increases raise the drag on fast ions, rapidly thermalizing some of the energy stored by beam ions, causing a transient rise in the plasma thermal energy. In addition, the global energy confinement time increases transiently. 26 refs., 7 figs., 1 tab.

38812 **(PPPL—2510) Time-dependent simulations of a Compact Ignition Tokamak.** Stotler, D.P.; Bateman, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1988. Contract AC02-76CH03073. 55p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011170/JAW.

Detailed simulations of the Compact Ignition Tokamak are carried out using a 1-1/2-D transport code. The calculations include time-varying densities, fields, and plasma shape. It is shown that ignition can be achieved in this device if somewhat better than L-mode energy confinement time scaling is possible. We also conclude that the performance of such a compact, short-pulse device can depend greatly on how the plasma is evolved to its flat-top parameters. Furthermore, in cases such as the ones discussed here, where there is not a great deal of ignition margin and the electron density is held constant, ignition ends if the helium ash is not removed. In general, control of the deuterium--tritium density is equivalent to burn control. 48 refs., 15 figs.

38813 **(PPPL—2512) Neutron spectroscopy on TFTR [Tokamak Fusion Test Reactor].** Nishitani, T.; Strachan, J.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1988. Contract AC02-76CH03073. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011169/JAW.

This paper describes the use of an ^{3}He ionization chamber for neutron spectroscopy on TFTR during 1987. The ion temperature was measured using neutron spectroscopy for one set of ohmically heated plasmas. The deduced ion temperatures agreed to within 20% with those measured by other diagnostics. 11 refs., 11 figs., 1 tab.

38814 **(PPPL—2513) Nonlinear gyrokinetic equations for tokamak microturbulence.** Hahm, T.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1988. Contract AC02-76CH03073. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011168/JAW.

A nonlinear electrostatic gyrokinetic Vlasov equation, as well as Poisson equation, has been derived in a form suitable for

particle simulation studies of tokamak microturbulence and associated anomalous transport. This work differs from the existing nonlinear gyrokinetic theories in toroidal geometry, since the present equations conserve energy while retaining the crucial linear and nonlinear polarization physics. In the derivation, the action-variational Lie perturbation method is utilized in order to preserve the Hamiltonian structure of the original Vlasov-Poisson system. Emphasis is placed on the dominant physics of the collective fluctuations in toroidal geometry, rather than on details of particle orbits. 13 refs.

38815 **(PPPL—2514) Orbit effects on impurity transport in a rotating tokamak plasma.** Wong, K.L.; Cheng, C.Z. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1988. Contract AC02-76CH03073. 40p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011167/JAW.

Particle orbits in a rotating tokamak plasma are calculated from the equation of motion in the frame that rotates with the plasma. It is found that heavy particles in a rotating plasma can drift away from magnetic surfaces significantly faster with a higher bounce frequency, resulting in a diffusion coefficient much larger than that for a stationary plasma. Particle orbits near the surface of a rotating tokamak are also analyzed. Orbit effects indicate that more impurities can penetrate into a plasma rotating with counter-beam injection. Particle simulation is carried out with realistic experimental parameters and the results are in qualitative agreement with some experimental observations in the Tokamak Fusion Test Reactor (TFTR). 19 refs., 15 figs.

38816 **(PPPL—2518) Soft x-ray camera for internal shape and current density measurements on a noncircular tokamak.** Fonck, R.J.; Jaehnig, K.P.; Powell, E.T.; Reusch, M.; Roney, P.; Simon, M.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1988. Contract AC02-76CH03073. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011872/JAW.

Soft x-ray measurements of the internal plasma flux surface shaped in principle allow a determination of the plasma current density distribution, and provide a necessary monitor of the degree of internal elongation of tokamak plasmas with a noncircular cross section. A two-dimensional, tangentially viewing, soft x-ray pinhole camera has been fabricated to provide internal shape measurements on the PBX-M tokamak. It consists of a scintillator at the focal plane of a foil-filtered pinhole camera, which is, in turn, fiber optically coupled to an intensified framing video camera ({DELTA}t {>=} 3 msec). Automated data acquisition is performed on a stand-alone image-processing system, and data archiving and retrieval takes place on an optical disk video recorder. The entire diagnostic is controlled via a PDP-11/73 microcomputer. The derivation of the polodial emission distribution from the measured image is done by fitting to model profiles. 10 refs., 4 figs.

38817 **(PPPL—2522) Neutral beam injection and plasma convection in a magnetic field.** Okuda, H.; Hiroe, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1988. Contract AC02-76CH03073. 46p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011875/JAW.

Injection of a neutral beam into a plasma in a magnetic field has been studied by means of numerical plasma simulations. It is found that, in the absence of a rotational transform, the convection electric field arising from the polarization charges at the edges of the beam is dissipated by turbulent plasma convection, leading to anomalous plasma diffusion across the magnetic field. The convection electric field increases with the beam density and beam energy. In the presence of a rotational transform, polarization charges can be neutralized by the electron motion along the magnetic field. Even in the presence of a rotational transform, a steady-state convection electric field and, hence, anomalous plasma diffusion can develop when a neutral beam is constantly injected into a plasma. Theoretical investigations on the convection electric field are described for a plasma in the presence of rotational transform. 11 refs., 19 figs.

38818 **(TRITA-EPP—86-6) Current limitation and formation of plasma double layers in a non-uniform magnetic field.** Plamondon, R.; Teichmann, J.; Torven, S. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Jul 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753031/JAW.

Formation of strong double layers has been observed experimentally in a magnetised plasma column maintained by a plasma source. The magnetic field is approximately axially homogenous except in a region at the anode where the electric current flows into a magnetic mirror. The double layer has a stationary position only in the region of non-uniform magnetic field or at the aperture separating the source and the plasma column. It is characterized by a negative differential resistance in the current-voltage characteristic of the device. The parameter space,where the double layer exists, has been studied as well as the corresponding potential profiles and fluctuation spectra. The electric current and the axial electric field are oppositely directed between the plasma source and a potential minimum which is formed in the region of inhomogeneous magnetic field. Electron reflection by the resulting potential barrier is found to be an important current limitation mechanism. (authors).

38819 **(TRITA-PFU—87-06) Plasma start-up, sustainment and stabilization by currents along a poloidal magnetic field.** Brunsell, P.; Tennfors, E. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Apr 1987. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752507/JAW.

The stability and heating effects of induced low frequency poloidal currents in the internal ring device F IV A have been studied. Density fluctuations are stabilized already at low power poloidal currents. At higher levels the temperature is increased. The start-up process is more efficient and works at lower filling pressures than without poloidal currents, resulting in lower plasma density and higher temperature. Rotating plasmas with density of 1.5x10/sp21/ m/sp-3/ were obtained for a filling pressure of 6 mtorr. At the lowest filling pressures, 0.2 mtorr, a non-rotating plasma, sustained only by the poloidal current, with a density of 1.5x10/sp20/m/sp-3/ and a temperature of 7 eV was produced. At this low density, the plasma is permeable to neutral gas, as opposed to the impermeable plasmas in the earlier experiments with this device. The stabilizing effect seems to be related to the applied toroidal magnetic field rather than the induced poloidal current. (authors).

38820 **(UCLA/PPG—1147) Presheath profiles in simulated tokamak edge plasmas.** LaBombard, B.; Conn, R.W.; Hirooka, Y.; Lehmer, R.; Leung, W.K.; Nygren, R.E.; Ra, Y.; Tynan, G. (California Univ., Los Angeles (USA)). Apr 1988. Contract FG03-86ER52134. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011709/JAW.

The PISCES plasma surface interaction facility at UCLA generates plasmas with characteristics similar to those found in the edge plasmas of tokamaks. Steady state magnetized plasmas produced by this device are used to study plasma-wall interaction phenomena which are relevant to tokamak devices. We report here progress on some detailed investigations of the presheath region that extends from a wall surface into these {open<-quotes}simulated tokamak{close<-quotes} edge plasma discharges along magnetic field lines.

38821 **(UCRL—98120) Radiative-hydro modeling and atomic data bases.** Nilsen, J. (Lawrence Livermore National Lab., CA (USA)). 26 Jan 1988. Contract W-7405-ENG-48. 8p. (CONF-870919—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011733/JAW.

From 6. topical conference on atomic processes in plasmas; Santa Fe, NM, USA (28 Sep 1987).

The methods by which we model high temperature plasmas will be described. The code XRASER is run on the Cray computers to simulate the kinetics, hydrodynamics, and radiation transfer in the high temperature plasma. Certain input is required by XRASER in the form of an atomic data file. The atomic data files are created using a variety of production atomic physics codes such as YODA. YODA will generate detailed energy levels, oscillator

strengths, photoionization cross sections, collisional excitation and ionization cross sections, and auger rates using relativistic multiconfiguration wavefunctions. This information is stored in an atomic data base. The code ADAM reads the atomic data from the data base and fills in the requested number of Rydberg energy levels based on a scaled hydrogenic approximation. ADAM adds the oscillator strengths, photoionization cross sections, and collisional excitation and ionization cross sections to connect the Rydberg levels with each other and also to connect the Rydberg levels with the detailed levels provided by YODA. The output of ADAM is in a format which XRASER understands. Using the atomic data file and a generator which specifies the plasma, XRASER is run to determine the time dependent properties of the plasma. 3 refs., 7 figs.

38822 **(UCRL—98278) Absolute calibration of a SPRED [Spectrometer Recording Extended Domain] EUV [extreme ultraviolet] spectrograph for use on the DIII-D tokamak.** Wood, R.D.; Allen, S.L. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 15p. (CONF-880364—29). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011317/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

We have performed an absolute intensity calibration of a SPRED multichannel EUV spectrograph using synchrotron radiation from the NBS SURF-II electron storage ring. The calibration procedure and results for both a survey grating (450 g/mm) and a high-resolution (2100 g/mm) grating are presented. The spectrograph is currently in use on the DIII-D tokamak with a tangential line-of-sight at the plasma midplane. Data is first acquired and processed by a microcomputer; the absolute line intensities are then sent to the DIII-D database for comparison with data from other diagnostics. Representative data from DIII-D plasma operations will be presented. 6 refs., 3 figs., 1 tab.

38823 **Propagation of a relativistic electron beam along an array of conductors.** Rambo, P.W.; Denavit, J. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics;* **64**: No. 2, 479-488(15 Jul 1988).

The propagation of a relativistic electron beam parallel to an array of parallel conductors, which provide charge and current neutralization of the beam, is investigated. Two geometries are studied: uniformly spaced planar foils or screens, and a matrix of parallel wires. The degree of charge and current neutralization and the resulting parallel and transverse fields are calculated for a uniform density pulse. The self-consistent transverse equilibrium is derived for the planar foil geometry. The effects of injection perpendicular to a planar cathode are investigated. Particle simulations in planar and cylindrical geometries are presented to confirm the analysis and to study edge effects and containment of the beam within the array. Comparison to vacuum drift tube operation shows that such arrays of conductors may allow beam transport with currents far exceeding the vacuum limit.

38824 **Relative ion expansion velocity in laser-produced plasmas.** Goldsmith, S.; Moreno, J.C.; Griem, H.R.; Cohen, L.; Richardson, M.C. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics;* **64**: No. 2, 581-585(15 Jul 1988).

The spectra of highly ionized titanium, TiXIII through TiXXI, and CVI Lyman lines were excited in laser-produced plasmas. The plasma was produced by uniformly irradiating spherical glass microballoons coated with thin layers of titanium and parylene. The 24-beam Omega laser system produced short, 0.6 ns, and high intensity, 4 x 10^{14} W/cm,^{2} laser pulses at a wavelength of 351 nm. The measured wavelength for the 2p-3s TiXIII resonance lines had an average shift of +0.023 A relative to the CVI and TiXX spectral lines. No shift was found between the CVI, TiXIX, and TiXX lines. The shift is attributed to a Doppler effect, resulting from a difference of (2.6 +- 0.2) x 10^7 cm/s in the expansion velocities of TiXIX and TiXX ions compared to TiXIII ions.

38825 **Long-range cross-field ion-beam propagation in the diamagnetic regime.** Papadopoulos, K.; Mankofsky, A.; Drobot, A. (Science Applications International Corporation, McLean, Virginia 22102). *Physical Review Letters;* **61**: No. 1, 94-97(4 Jul 1988).

It is shown that high—kinetic-β neutralized ion beams with transverse width less than an ion gyroradius and density larger than the background plasma density can propagate uninhibited through a magnetized plasma over many ion gyroradii. The model is confirmed by computer simulations using a two-dimensional hybrid code.

38826 **Wave-breaking amplitude of relativistic oscillations in a thermal plasma.** Katsouleas, T.; Mori, W.B. (University of California, Los Angeles, Los Angeles, California 90024). *Physical Review Letters;* **61**: No. 1, 90-93(4 Jul 1988).

The maximum amplitude of relativistic plasma oscillations (v/sub ph/ near c) is obtained with a combined one-dimensional waterbag and warm-fluid model. The waterbag description is used to obtain expressions for the pressure and internal energy as functions of the proper density. A relativistic Euler's equation that is valid for arbitrarily large amplitudes and an analytic expression for the wave-breaking amplitude in the limit v/sub ph/=c are obtained. Even a small amount of thermal energy can significantly reduce the maximum plasma-wave amplitude relative to the cold wave-breaking value. The significance of the results for recent accelerator schemes is discussed.

38827 **Grazing incidence technique to obtain spatially resolved spectra from laser heated plasmas.** Behring, W.E.; Underwood, J.H.; Marshall, F.J.; Richardson, M.C.; Brown, C.M.; Feldman, U.; Seely, J.F. (NASA Goddard Space Flight Center, Laboratory for Astronomy & Solar Physics, Greenbelt, Maryland 20771). *Applied Optics;* **27**: No. 13, 2762-2767(1 Jul 1988).

An experimental method is described in which a grazing incidence spectrograph is used to obtain spatially resolved spectra of laser heated plasmas in the 6—370-A region. In the experiment, small target spheres were irradiated by tightly focused laser beams. A tilted grazing incidence elliptical mirror placed 1.3 m from the target focuses the plasma radiation on the spectrograph slit at a distance of 0.7 m producing a useful degree of spatial resolution in the recorded spectral lines. The spectrum from a copper target is presented together with an x-ray pinhole camera image of the plasma.

38828 **Simulation of oscillating field current drive on the reversed-field pinch.** Harned, D.S.; Schnack, D.D.; Strauss, H.R.; Nebel, R.A. (Science Applications International Corporation, San Diego, California 92121). *Physics of Fluids;* **31**: No. 7, 1979-1987(Jul 1988).

Oscillating field current drive on the reversed-field pinch is simulated by using a three-dimensional nonlinear resistive magnetohydrodynamic model in conjunction with a one-dimensional hyperresistive model. When input from the three-dimensional model is used for fluctuating fields in the hyper-resistive equations, the two models are found to give similar relaxed profiles. Comparisons are made with experiments on the Los Alamos National Laboratory ZT-40M reversed-field pinch device [Nucl. Fusion 25, 1321 (1985)]. Simulation results indicate that the oscillation period must be much less than the resistive decay time, but should not be much less than the hyper-resistive relaxation time, in order to maintain reversal without a steady-state driving field.

38829 **Compression of ultrahigh magnetic fields in a gas-puff Z pinch.** Felber, F.S.; Malley, M.M.; Wessel, F.J.; Matzen, M.K.; Palmer, M.A.; Spielman, R.B.; Liberman, M.A.; Velikovich, A.L. (JAYCOR, P. O. Box 85154, San Diego, California 92138). *Physics of Fluids;* **31**: No. 7, 2053-2056(Jul 1988).

Evidence is presented that an axial magnetic field of 100 kG has been compressed to 42 MG by an imploding neon gas-puff Z pinch on a 800 kJ, 7.5 MA, 60 nsec pulsed power generator. Machine electrical diagnostics and x-ray pinhole photographs indicate that this 420-fold field compression was produced by imploding plasma at high magnetic Reynolds number.

38830 Tomography and reliable information. Howard, J. (Plasma Research Laboratory, Research School of Physical Sciences, Australian National University, Canberra, A.C.T., Australia). *Journal of the Optical Society of America A: Optics and Image Science;* **5**: No. 7, 999-1014(Jul 1988).

Principles of tomography are developed and applied to the problem of two-view interferometry on a tokamak plasma. It is shown that M equispaced views, or projections, of a two-dimensional object yield precisely M^2+M numbers characterizing the object. This result is an extension of the previous work of Niland [J. Opt. Soc. Am. 72, 1677 (1982)], who proved that M^2 generalized Fourier coefficients, or moments of the object, could be retrieved by M-view tomography. Furthermore it is shown that only half of the alias-free numbers are useful in reconstructing a uniform image of the unknown object. Questions of sampling within a view are addressed and the aliasing contaminants explicitly identified. An algorithm using an orthogonal expansion in the frequency domain is used to examine the attributes of the image reconstructed using various subsets of the available Fourier coefficients.

38831 H/sub α/ studies on the Tokamak Fusion Test Reactor. Heifetz, D.H.; Ehrhardt, A.B.; Ramsey, A.T.; Dylla, H.F.; Budny, R.; McNeill, D.; Medley, S.; Ulrickson, M. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 4, 2564-2567(Jul 1988).

H/sub α/ emission is a useful indicator of hydrogen ionization since the energy required to excite hydrogen to the n = 3 level is approximately the same as to ionize the hydrogen atom. Other aspects of recycling, such as plasma scrapeoff parameters, wall particle fluxes, and wall retention rates can be inferred from spatial distributions of H/sub α/ emission. There are two H/sub α/ diagnostics on the Tokamak Fusion Test Reactor (TFTR) observing the inner limiter: a relatively calibrated wide-angle television camera, and the absolutely calibrated H/sub α/ interference filter array (HAIFA) diagnostic, both viewing the inner limiter. H/sub α/ observations by these instruments have been analyzed using the d-smcapsEg-smcapsAS neutral transport code. The core recycling rate, and ion and neutral particle limiter fluxes, have been deduced from the calculations. The results are very sensitive to the ion flux distribution, and therefore also provide information on the plasma scrapeoff conditions. A survey was made of over 500 TFTR discharges. H/sub α/ emission appears to increase in proportion to n-bar^2/sub e/. The ratio of the core ionization to average H/sub α/ emission was calculated to be roughly constant over a large range of discharges.

38832 Nonlinear gyrokinetic theory for finite-beta plasmas. Hahm, T.S.; Lee, W.W.; Brizard, A. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids;* **31**: No. 7, 1940-1948(Jul 1988).

A self-consistent and energy-conserving set of nonlinear gyrokinetic equations, consisting of the averaged Vlasov and Maxwell's equations for finite-beta plasmas, is derived. The method utilized in the present investigation is based on the Hamiltonian formalism and Lie transformation. The resulting formulation is valid for arbitrary values of k/sub perpendicular/rho/sub i/ and, therefore, is most suitable for studying linear and nonlinear evolution of microinstabilities in tokamak plasmas as well as other areas of plasma physics where the finite Larmor radius effects are important. Because the underlying Hamiltonian structure is preserved in the present formalism, these equations are directly applicable to numerical studies based on the existing gyrokinetic particle simulation techniques.

38833 Three-dimensional global numerical simulation of ion temperature gradient mode turbulence. Waltz, R.E. (General Atomics, San Diego, California 92138—5608). *Physics of Fluids;* **31**: No. 7, 1962-1967(Jul 1988).

Three-dimensional global numerical simulations of ion temperature gradient mode turbulence in a sheared and curved magnetic field corresponding to tokamak geometry is obtained. The key result demonstrates that there is no significant dependence of the bulk heat transport on the edge safety factor q in agreement with analytic theories. The motivation for this question in relation to tokamak experiments is discussed.

38834 Lyapunov stability analysis of magnetohydrodynamic plasma equilibria with axisymmetric toroidal flow. Almaguer, J.A.; Hameiri, E.; Herrera, J.; Holm, D.D. (Centro de Estudios Nucleares, Universidad Nacional Autonoma de Mexico, Mexico 20, D.F., Mexico). *Physics of Fluids;* **31**: No. 7, 1930-1939(Jul 1988).

Lyapunov stability conditions for ideal magnetohydrodynamic (MHD) plasmas with mass flow in axisymmetric toroidal geometry are determined in the Eulerian representation. Axisymmetric equilibrium solutions of ideal MHD are associated to critical points of a nonlinearly conserved Lyapunov functional consisting of the sum of the total energy and the following flux-weighted quantities: the circulation along field lines, the angular momentum, the toroidal flux, and the mass content within each flux tube. Conditions sufficient for Lyapunov stability of these equilibria against axisymmetric perturbations are found by taking advantage of the Hamiltonian formalism for ideal MHD. In particular [see Eq. (60)], it is sufficient for Lyapunov stability under linearized dynamics that an axisymmetric equilibrium be subsonic in the appropriate rotating frame, lie in the first elliptic regime of the Bernoulli—Grad—Shafranov (BGS) system of equations, and satisfy one additional, more complicated, condition. Effects of boundary conditions, nonlinearity, and three-dimensionality on MHD stability are also discussed.

38835 "Moderate-m" ballooning modes in quadrapole stabilized tandem mirrors. Nevins, W.M.; Pearlstein, L.D. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids;* **31**: No. 7, 1988-1998(Jul 1988).

The beta limits on the central cells of nonaxisymmetric tandem mirrors due to moderate-m ballooning modes are studied. Both finite Larmor radius (FLR) effects and corrections associated with the finite extent of the ballooning modes in the plane perpendicular to B are retained. The assumption of short perpendicular wavelength together with the large ellipticity of the flux surfaces near the magnetohydrodynamic (MHD) anchor cells allows a reduction of the three-dimensional problem into a sequence of three one-dimensional problems. The marginal stable boundary for the Mirror Fusion Test Facility (MFTF-B) (National Technical Information Service Document Nos. 82020108 and UCID-19359) is calculated and compared with that obtained from a low mode number calculation.

38836 Experimental studies of divertor stabilization in an axisymmetric tandem mirror. Casey, J.A.; Lane, B.G.; Irby, J.H.; Brau, K.L.; Golovato, S.N.; Guss, W.C.; Kesner, J.; Post, R.S.; Sevillano, E.; Zielinski, J.; and others. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **31**: No. 7, 2009-2016(Jul 1988).

A divertor coil set has been installed on the Tara tandem mirror [Nucl. Fusion 22, 549 (1982); Plasma Physics and Controlled Nuclear Fusion Research 1984 (IAEA, Vienna, 1985), Vol. 2, p. 285] for stabilization of m = 1 flutelike modes. The effectiveness of divertor stabilization is discussed in experiments where m = 1 modes are driven to instability by plug electron cyclotron heating (ECH) in an ion cyclotron heated (ICH) plasma. The instability onset is characterized by thresholds in ECH power, fueling rate, ICH power, and mapping radius of the divertor null. In general, the stability is enhanced by mapping the null radially inwards into the plasma. The interdependence of these parameters and their effect on equilibrium profiles and stability boundaries are discussed.

38837 Excitation of ion Bernstein waves from loop antennas. Skiff, F.; Ono, M.; Wong, K.L. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids;* **31**: No. 7, 2030-2036(Jul 1988).

Direct excitation and propagation of ion Bernstein waves from low-impedance current-carrying loop antennas in the ion cyclotron frequency range are studied over a range of plasma and antenna parameters. The dependence of wave coupling efficiency on plasma density and on wave frequency and parallel wavelength is obtained from measurements of wave amplitude and variations in antenna impedance. Comparisons are made to a simple nonuniform

warm-plasma model of the coupling problem. Generally good agreement is found between theory and experiment. As a result, some guidelines are proposed concerning antenna design.

38838 **Negative ion-acoustic solitons in a two-component magnetized plasma.** Song, L.T.; Lee, L.C.; Huang, L. (Department of Geophysics, Peking University, Beijing, People's Republic of China). *Physics of Fluids;* **31**: No. 6, 1549-1553(Jun 1988).

Ion-acoustic solitons in a two-component low-beta plasma are studied. It is found that under the quasineutrality condition only positive ion-acoustic solitons can exist in such a plasma. When the effect of charge separation is included, both positive and negative solitons can be found for C/sub s/ cos θ<V/sub p/<C/sub s/. Here θ is the angle between the wave vector and the magnetic field, C/sub s/ is the ion-acoustic velocity, and V/sub p/ is the phase speed. The amplitudes of the positive and negative solitons as a function of θ and V/sub p/C/sub s/ are also calculated.

38839 **Plasma oscillation bursts and scattering of intermediate energy alpha particles.** Coppi, B.; Porcelli, F. (Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA (US)). *Fusion Technology;* **13**: No. 3, 447-452(Mar 1988).

The possibility that plasma oscillation bursts ("fishbones") could be excited in a fusion burning plasma is pointed out. The relevant instability is brought about by the resonant interaction between an m/sup 0/ = 1 mode and slowed down alpha particles in the 300- to 400-keV energy range. The resulting resonant scattering of these intermediate energy particles does not appear to affect significantly the alpha-particle heating power. The drift of the banana orbits of 3.5-MeV alpha particle in the fluctuating field associated with this instability and the possible secondary instabilities driven by the locally depleted alpha-particle distribution function may have more serious consequences.

38840 **Modification of Tokamak ballooning stability boundaries by alpha populations.** Spong, D.A.; Sigmar, D.J.; Ramos, J.J. (Oak Ridge National Lab., Oak Ridge, TN (US)). *Fusion Technology;* **13**: No. 3, 428-431(Mar 1988).

For T/sub α//T/sub i/ < 150 (where T/sub α/ is the alpha-mean energy and T/sub i/ the ion temperature), the trapped alpha precision resonance destabilizes the kinetic ballooning mode of the bulk plasma. Using a slowing down distribution and both circular and noncircular equilibrium models, the eigenfrequencies of the resonant ballooning integral equation are computed. One finds lower critical betas and a widening of the unstable region particularly at higher electron temperature and for flat q, steep pressure profiles typical of ignited sawtoothing plasmas.

38841 **On reflection from a suddenly created plasma half-space: Transient solution.** Kalluri, D.K. (Dept. of Electrical Engineering, Univ. of Lowell, Lowell, MA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 1, 11-16(Feb 1988).

The reflection by a suddenly created plasma half-space of a time-harmonic plane electromagnetic wave propagating in free space is considered. The problem involves a temporal discontinuity, a spatial discontinuity, and a dispersive medium. The steady-state solution is obtained by considering the basic features of the scattering processes due to each of the discontinuities in terms of analogous transmission-line models. The electric field of the reflected wave consists of two components. One component (called component A) is of the same frequency as the incident wave frequency and is due to the spatial discontinuity. The other component (called component B) is of a different frequency and arises because of the temporal discontinuity. The B components is damped out even if the plasma is only slightly lossy. The damping rate of the B component is calculated. The transient solution is obtained through the use of Laplace transforms. The solution is given in terms of Bessel-like functions. The limiting value of this solution is shown to agree with the steady-state solution. Numerical results illustrating the transient effects are given for two typical cases.

38842 **Scrapeoff layer studies with an instrumented limiter.** Mioduszewski, P.K.; Edmonds, P.H.; Emerson, L.C.; Simpkins, J.E. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC05-84OR21400.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

An instrumented limiter was used as a diagnostic to measure energy deposition and power fluxes in the scrapeoff layer. The limiter consisted of an array of 12 tiles, each equipped with a thermocouple. This arrangement represented a calorimeter array that yielded the total limiter energy and decay length of the power flux in the scrapeoff layer. Energy deposition and decay lengths are discussed for various plasma parameters.

38843 **Asymmetries in the density at the edge of a tokamak plasma.** Watkins, J.G.; Yokoyama, K.E.; Wootton, A.J. (Sandia National Labs., Albuquerque, NM (USA); Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC04-76DP00789;AC05-84OR21400.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Several Langmuir probes were used simultaneously to observe density asymmetries at the edge of the beam-heated tokamak ISX-B. The large number of identical discharges required for the joint JET/ISX-B beryllium limiter experiment offered the opportunity to perform a careful edge study of the scrape-off layer using probes at various poloidal, toroidal, and radial locations. Floating, double, Langmuir probes were used at 3 separate locations. Edge density asymmetries were observed and correlated with the local connection length along a field line between material surfaces in the scrape-off layer. The effects of limiter movement were also explored with limiters other than the main limiter. It was observed that the asymmetries were altered somewhat when either the magnetic field or the plasma current was reversed. These spatial variations were accentuated locally when a certain critical density was exceeded and may be due to enhanced recycling at the main limiter just below the disruption-limited maximum density.

38844 **Effects of ICRH on the edge plasma in TMX-U tandem mirror.** Hsu, W.L.; Causey, R.A.; Wilson, K.L.; Cummins, W.F.; Molvik, A.W. (Sandia National Labs., Livermore, CA (USA); Lawrence Livermore National Lab., CA (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—).

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

A Langmuir probe was used to study the effects of ICRH on edge plasmas in TMX-U. Two types of antenna configurations were used for plasma heating, the slot and the loop. During slot antenna operation, the electron temperature near the limiter cutoff radius increased from 30 to 70 eV with 180 kW of transmitted power at slot frequencies ranging from 0.65 < $\omega\omega$/sub ci/ $\leqq$ 1.00. In contrast, the loop antenna showed little heating of edge electrons. The observed edge heating occured without necessarily a concurrent heating of the core electrons. The predicted result based on McVey ANTENA code was also in good qualitative agreement with the observed edge heating. These analyses suggest that Landau and collisional damping of the T-M surface plasma wave was the main mechanism for edge heating. Results on edge density behavior during ICRH are also presented.

38845 **Global particle recycling with ohmic and neutral beam heating in TFTR.** Shimada, M.; Ramsey, A.T.; Owens, D.K.; Dylla, H.F.; Budny, R.V.; Lomarche, P.H.; Schivell, J.F.; Heifetz, D.; Groebner, R.J.; Murakami, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.; GA Technologies, Inc., San Diego, CA (USA); Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC02-76CH03073.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

High I/sub p/, high n/sub e/ TFTR discharges exhibit a strong density increase throughout most of the period of 0.5 s neutral beam pulses. This increase is consistent with beam fueling. On the other hand, low I/sub p/, low n/sub e/ discharges show n/sub e/ saturation shortly after the beam turn-on. The latter phenomenon has been observed in smaller devices operated at lower I/sub p/ ('density-clamping'). The H/sub α/ emission near the limiter shows a strong density and plasma current scaling [(anti n/sub e/I/sub p/)^2] but shows little change with beam power toroidal field, and plasma species, or with a change in wall condition (with and without Cr gettering and ZrAl gettering).

38846 **Particle flux measurements with pump limiters.** Mioduszewski, P. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials*; **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC05-84OR21400.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The pressure buildup in pump limiters is a function of the incident particle flux, the pump limiter geometry, particle-surface interactions, and effects due to interactions of the neutral gas with the incoming plasma. At sufficiently low density and for a short pump limiter throat, the pressure observed in the pump limiter chamber is a direct measure of the particle flux at the limiter slot. This paper discusses a simple model for the correlation between particle flux and pump limiter pressure in ISX-B. In addition, some estimates are presented on the thermalization of fast neutrals in the pump limiter duct and its implications for 'enhanced particle collection'.

38847 **Maximum entropy method of spectral estimation as a fluctuation diagnostic.** Levinson, S.J.; Koh, T.; Kim, S.B.; Powers, E.J. (Dept. of Electrical and Computer Engineering, Univ. of Texas at Austin (US)). pp 37 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

In this paper, the authors compare the relative advantages and limitations of the maximum entropy methods (MEM) of spectral estimation with the more conventional fast Fourier transform (FFT) approach. Specifically, they discuss the ability of the MEM method to estimate, with increased frequency resolution and smaller variance, fluctuation-induced particle transport for relatively short duration data records. A simulation of plasma potential and density fluctuation data is first performed in order to quantitatively compare MEM and conventional FFT spectral estimates with known results. Next, they compare MEM and FFT techniques for three different data sets. The three data sets and the results are described in this paper.

38848 **Plasma energy balance model for optical-laser-induced impulse in vacuo.** Dingus, R.S.; Goldman, S.R. pp 111-122 of Lasers '86; Proceedings of the Ninth International Conference on Lasers and Applications, Orlando, FL, Nov. 3-7, 1986. Mcmillan, R.W. Atlanta, GA; Georgia Institute of Technology (1987). (CONF-861177—).

From 9. international conference on lasers and applications; Orlando, FL, USA (3 Nov 1986).

A simple plasma energy-balance model, along with its derivation, is presented for calculating the impulse from targets in a vacuum exposed to single-pulse optical lasers. Results from the model agree well with experimental data and LASNEX radiation-hydrodynamic computer code calculations. The model assumes isothermal blowoff and thus takes advantage of the insensitivity of impulse to energy distribution within the ablated mass. The success of the model indicates that the impulse is insensitive to detailed interactions in the vicinity of the ablation surface. 10 references.

38849 **ICRF enhanced potentials.** Nelson, B.A. Madison, WI; Univ. of Wisconsin (1987). 309p. University Microfilms Order No. 87-16,532.

Thesis (Ph. D.).

Ion-confining potentials in the Phaedrus tandem mirror are shown to be enhanced over Boltzmann-relations predicted values by radio-frequency (rf) waves in the ion cyclotron range of frequencies (ICRF). The ICRF enhanced potential is larger in the end cell with a lower passing density. Peak potential values decrease with increasing ion endloss current (or central cell density) for a constant rf capacitor bank voltage, and increase with increasing rf-capacitor bank voltage, for a constant ion endloss value (or central cell density). In fully axisymmetric operation, a potential peak is produced in an end cell by the central-cell rf, (with-out end-cell rf) and is found only in the end cell nearer the central-cell antenna. ICRF enhanced potentials are explained as an equilibrium between the electron-collisional filling-in rate and the electron pumping out rate provided by axial time-varying electric fields. Thermal barrier-like potential structures were found in the transition regions between the central cell and end cells, in the fully axisymmetric Phaedrus. Central-cell ICRF trapping effects combined with end-cell $\mu\Delta$ B forces create and pump the barrier potential wells.

38850 **Alpha loss-cone instability in the central cell of a tandem-mirror reactor.** Ho, S.K. Urbana-Champaign, IL; Univ. of Illinois (1987). 225p. University Microfilms Order No. 87-21,658.

Thesis (Ph. D.).

D-T fusion-born alpha particles are mirror-confined in the central cell of a tandem-mirror reactor. The resulting anisotropic loss-cone distribution of the alpha particles in velocity space is capable of destabilizing low-frequency plasma waves, thus affecting the energy balance in a tandem mirror plasma. The low-frequency waves of a cold, cylindrical, sharp-boundary, D-T plasma are studied. Techniques were developed to trace the wave-propagation regions and search the wave eigenfrequencies. Three branches of waves are found, namely the Alfven, hybrid, and fast waves; but only the Alfven wave is destabilized by the alpha loss-cone instability. The modeling of the alpha distribution function for the linear and quasi-linear instability calculations is done by a diffusion-front method and a numerical finite-difference method, respectively. The growth rate of the instability is basically determined by the alpha number density, the loss-cone angle, and the polarization of the wave. These quantities are in turn mainly affected by the density and temperature of the plasma ions and electrons, the mirror ratio, and the plasma radius. A stability boundary in the n-T plane is constructed to locate the stable and unstable regions. The instability is found to occur with moderate values of plasma density and temperatures.

38851 **Experimental studies of the rotational stability of the Phaedrus Tandem Mirror.** Severn, G.D. Madison, WI; Univ. of Wisconsin (1987). 185p. University Microfilms Order No. 87-20,484.

Thesis (Ph. D.).

It is demonstrated that the radial electric field in the Phaedrus Tandem Mirror can be altered using Plasma Potential Control rings (PPC rings) situated at each end of the device, and the azimuthal plasma rotational velocity may thus be varied. A simple calculation to model the change in central-cell potential due to a bias voltage applied to the PPC rings is presented. Low-frequency ($w << w/sub ci/$), low azimuthal mode number ($m = -1$ and $m = -2$) instabilities drive by E x B rotation were observed. The radial potential profile was experimentally variable using the same method for the case that Phaedrus was operated as an axisymmetric tandem mirror with MHD stability provided by the RF ponderomotive force. Instabilities having azimuthal $m = -1$, -2, and -3 ($W << w/sub ci/$), were observed to occur as E x B was increased. The destabilizing centrifugal force due to E x B rotation was compared to the destabilizing curvature force and RF ponderomotive force and found to account for the observed instabilities.

38852 **Quasi-linear saturation of the drift-cyclotron loss-cone mode.** McCarrick, M.J. College Park, MD; Univ. of Maryland (1987). 164p. University Microfilms Order No. 87-25,418.

Thesis (Ph. D.).

The drift-cyclotron loss-cone instability (DCLC) is observed to grow to large amplitudes and subsequently saturate through non-

linear processes in MIX-1, a small magnetic mirror machine. The amplitude at which the mode saturates is a sensitive function of the ion energy distribution function, and of the mirror ratio (B/sub max/B/sub min/) of the device. Direct experimental measurements are made of the wave properties including growth time, saturation amplitude, real frequency, and wave number. Simultaneous measurements determine the ion energy distribution as a function of time. The experimentally measured saturated state is compared to the predictions of a quasi-linear diffusion theory. The quasi-linear calculation predicts that the unstable wave will grow to a sufficient level so as to turbulently scatter trapped ions into the loss-cone region, thereby forcing the mode to marginal stability. This source of loss-cone ions balances the concomitant loss rate of unconfined ions, determining the self-consistent saturation amplitude.

38853 **Experimental studies of plasma heating due to the parametric decay of alarge-amplitude pump into lower-hybrid waves.** Harper-Slaboszewicz, V.J. Davis, CA; Univ. of California (1987). 132p. University Microfilms Order No. 87-23,395.

Thesis (Ph. D.).

Plasma heating of a high-density low-temperature linear plasma by the parametric decay instability of lower-hybrid waves excited in a parallel-plate geometry is studied experimentally for ww/sub lh/ = 3 and 10. The electric-field distribution is modeled considering the higher-order modes produced in this geometry. A method of measuring bulk electron temperature in the presence of an oscillating potential is developed and validated. Electron-heating results show that the parametric decay instability in this geometry is strongly driven and strongly convectively damped, resulting in very rapid electron heating that saturates in a time of 20-30w^{-1}. Bulk electron heating consistent with a recent theory of parametric decay of a large-amplitude driver near the lower-hybrid frequency is also observed. Control of the instability by use of a finite-bandwidth driver is also studied, and results show that the threshold of the parametric decay instability in this geometry can be increased by a factor of 3 by a noise-modulated driver with Δww - .7. These results are contrasted with earlier studies.

38854 **Waves and instabilities in plasmas.** Chen, L. Teaneck, NJ; World Scientific Pub. Co. (1987). 250p. World Scientific Pub. Co., 687 Hartwell Street, Teaneck, NJ 07666.

The contents of this book are: Plasma as a Dielectric Medium; Nyquist Technique; Absolute and Convective Instabilities; Landau Damping and Phase Mixing; Particle Trapping and Breakdown of Linear Theory; Solution of Viasov Equation via Guilding-Center Transformation; Kinetic Theory of Magnetohydrodynamic Waves; Geometric Optics; Wave-Kinetic Equation; Cutoff and Resonance; Resonant Absorption; Mode Conversion; Gyrokinetic Equation; Drift Waves; Quasi-Linear Theory; Ponderomotive Force; Parametric Instabilities; Problem Sets for Homework, Midterm and Final Examinations.

38855 **Investigations of stimulated Raman scattering from high-density underdense plasmas irradiated by a 0.35-micron laser.** Figueroa Lopez, H.G.T. Los Angeles, CA; Univ. of California (1986). 145p. University Microfilms Order No. 87-23,164.

Thesis (Ph. D.).

Studies of stimulated Raman back and forward scattering and the generation of high-energy electrons at 0.35 microns are presented. To isolate the various phenomena occurring at different densities, attempts were made to control the plasma density by varying the thickness of the foil targets and also by using foam targets of variable average density. The frequency of the scattered light is used as a diagnostic to measure the plasma density. Time-resolved and time-integrated spectra for various plasma densities are discussed. Also, the measured energy and angular distribution of the high-energy electrons from foil targets are presented. Two-plasmon decay is suggested as the probable mechanism generating the hot electrons.

38856 **Pump-limiter experiments and analysis in the TEXTOR tokamak.** Campbell, G.A. Los Angeles, CA; Univ. of California (1986). 173p. University Microfilms Order No. 87-23,160.

Thesis (Ph. D.).

The ALT-1 pump limiter was used effectively for particle control in the TEXTOR tokamak. Two distinctively different pump-limiter modules gave markedly different performance. Operation both as the main limiter and in the shadow of the main TEXTOR limiters allowed evaluation of the pump limiter over a wide range of incident plasma parameters. Incident ion fluxes of up to 9.5 X 10^{18} $cm^{+2}s^{-1}$ are measured with Langmuir probes mounted on ALT-1. Pressures of up to 3 mtorr are measured in the large (700 l) ALT-1 vacuum chamber with no active pumping. With active pumping (7000 l/s) particle-removal rates of up to 7 torrl/s are measured. The pressure rise in the pump limiter is strongly dependent on the interaction of neutrals with the edge plasma. The experimental results are found to agree closely with a 3-D Monte-Carlo neutral-transport code that includes the atomic physics of the plasma-neutral interaction. Langmuir probes mounted directly on the ALT limiter, and a scanning probe located 90° toroidally from the limiter are used to characterize the edge plasma.

38857 **Helically linked mirror arrangement.** Ranjan, P. Berkeley, CA; Univ. of California (1986). 115p. University Microfilms Order No. 87-18,131.

Thesis (Ph. D.).

A scheme of helical linking of mirror sections is described, which endeavors to combine the better features of toroidal and mirror devices by eliminating the longitudinal loss of mirror machines, that have moderately high average β and steady-state operation. The scheme is aimed at a device, with closed magnetic surfaces having rotational transform for equilibrium, one or more axisymmetric straight sections for reduced radial loss, a simple geometrical axis for the links, and an overall positive magnetic well depth for stability. A description of the helically linked mirror scheme is given. This example has three identical straight sections connected by three sections having helical geometric axes. A theoretical analysis of the magnetic field and single-particle orbits in them leads to the conclusion that most of the passing particles would be confined in the device and they would have orbits independent of pitch angle under certain conditions. Numerical results presented agree well with theoretical results as far as passing particle orbits are concerned. Some consideration of the stability of linked mirrors is presented.

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REFER ALSO TO CITATION(S) 35866, 36803, 37318, 37331, 37459, 37569, 38341, 38533, 38643, 38819

38858 **(ANL/FPP/TM—220) Erosion/redeposition modeling and calculations for carbon.** Brooks, J.N.; Brice, D.K.; Dewald, A.B.; McGrath, R.T. (Argonne National Lab., IL (USA); Sandia National Labs., Albuquerque, NM (USA); Georgia Inst. of Tech., Atlanta (USA)). Apr 1988. Contract W-31109-ENG-38;AC04-76DP00789. 21p. (SAND—87-2868C; CONF-880512—5). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010382/JAW.

From 8. international conference on plasma surface interactions in controlled fusion devices; Julich, F.R. Germany (2 May 1988).

Several key aspects of carbon erosion/redeposition in fusion devices have been examined. These include the effects of an oblique magnetic field geometry plasma sheath on ion impingement and sputtering, and the effect of surface hydrogen buildup on sputtering. The calculations use a version of the MEASTRI hydrogen implantation code and a cloud-in-cell type sheath code. Time dependent erosion calculations have been made for the TFTR bumper limiter, using the REDEP erosion/redeposition code with updated sheath and sputtering modes. The computed plasma carbon content during a TFTR limiter "deconditioning" run and for a "supershot" beam heating case is similar to measured values. The calculations predict that depletion of the near surface graphite hydrogen concentration enhances the self and hydrogen sputtering coefficients. This mechanism provides an explanation for the larger Z-effective values observed on TFTR immediately after limiter conditioning. 21 refs., 6 figs.

38859 (CEA-CONF—9203) Comparison between positive ion with electrostatic recovery and negative ion based neutral system. Jacquot, C. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Jul 1987. 8p. (CONF-870787—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752558/JAW.

From International Atomic Energy Agency technical committee meeting on negative ion beam sources; Culham, UK (15 Jul 1987).

To achieve the efficiency and cost goals required for plasma heating and non-inductive current drive, two neutral beam system solutions can be envisaged and choice between them depends strongly of the neutral energy. The first one is the positive ion with electrostatic recovery based neutral system and the other is the negative ion based neutral system. In this paper a comparison of the two systems is presented in order to inject 50 MV of D/sub o/ in steady state with a total efficiency around 0.5.

38860 (CEA-CONF—9207) Tore-Supra: a Tokamak with superconducting toroidal field coils. Turck, B. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Jul 1987. 23p. (CONF-870790—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752560/JAW.

From 1. European workshop on high T/sub c/ superconductors and potential applications; Genova, Italy (1 Jul 1987).

Tore Supra is a tokamak under construction on the site of Cen Cadarache by the Euratom-CEA Association. The machine technology integrates all problems related to the fabrication and the operation of large superconducting coils and of the associated cryogenic system. Tore Supra will provide a significant experience to prepare the next generation of machines for plasma physics and controlled fusion. Tore Supra is specially designed to implement a large physics program. The superconducting coils make possible the study of plasma confinement in long pulses (more than 60s), the impurities and the stability, and the efficiency of additional heating sources (neutral particle beams and radio frequency heating). The opportunity is taken to recall the particular features and requirements of the superconducting coils of the large future tokamaks in order to point out the problems that have to be faced by any new material (superconducting or not).

38861 (CEA-CONF—9300) Non linear self consistency of microtearing modes. Garbet, X.; Mourgues, F.; Samain, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 14p. (CONF-8708235—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753471/JAW.

From International school of plasma physics; Varenna, Italy (24 Aug 1987).

The self consistency of a microtearing turbulence is studied in non linear regimes where the ergodicity of the flux lines determines the electron response. The current which sustains the magnetic perturbation via the Ampere law results from the combined action of the radial electric field in the frame where the island chains are static and of the thermal electron diamagnetism. Numerical calculations show that at usual values of β/sub pol/ in Tokamaks the turbulence can create a diffusion coefficient of order ν/sub th/ρ^2/sub i/ where ρ/sub i/ is the ion larmor radius and ν/sub th/ the electron ion collision frequency. On the other hand, collisionless regimes involving special profiles of each mode near the resonant surface seem possible.

38862 (CLM-R—278) Study of the reactor relevance of the NET design concept. Reynolds, P.; Worraker, W.J. (comps.). (UKAEA Culham Lab., Abingdon). Aug 1987. 403p. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

The objective of the study was to explore the reactor relevance of NET, i.e. whether the technologies and design principles proposed for NET can be directly extrapolated to a demonstration power reactor (DEMO). The main areas of study were those near to the plasma, namely the divertor, first wall and tritium breeding blanket. Other aspects which were investigated were tritium permeation and recovery, reactor maintenance, afterheat and effects of disruptions. The principal results of the study are briefly presented; the details of the work are given in fourteen appendices. These appendices were selected for INIS and indexed separately. The overall conclusion of the study is that the NET design is only partly relevant to the design requirements of a DEMO reactor. (U.K.).

38863 (CLM-R—278, pp A1-1-A1-5) On the definition of a DEMO (demonstration) reactor. Appendix 1. Cole, H.C.; Challender, R.S. (UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

The paper is an appendix to a study of the reactor relevance of the NET design concept. The latter study examines whether the technologies and design principles proposed for NET can be directly extrapolated to a demonstration (DEMO) reactor. The authors have suggested a definition of a DEMO, and listed what they considered to be the most important implications of this definition. A table of parameters is included comparing published DEMO's with typical commercial reactor and 'pre-DEMO' studies. (U.K.).

38864 (CLM-R—278, pp A2-1-A2-15) Parameter set for a double-null DEMO reactor. Appendix 2. Cooke, P.I.H. (UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

The present study is aimed at commenting on the reactor-relevance of the design principles and technology being proposed for NET. The authors propose that a double-null device serve as a basis for a NET-based demonstration reactor. Calculations are carried out to determine the parameter set for reactors based on the double-null NET design, and the results are presented in tabular form. (U.K.).

38865 (CLM-R—278, pp A3-1-A3-21) Poloidal field calculations for a double-null DEMO reactor. Appendix 3. Cooke, P.I.H. (UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

This note describes calculations performed on the poloidal field (PF) coil system for the double-null divertor DEMO reactor, which is the focus of our current study. The design of the PF coil system is very sensitive to the details of the plasma configuration and the operating scenario and represents an important area in commenting on the reactor-relevance of the NET design. The PF coils for NET DN and the proposed operating scenario have, therefore, been adapted to the different parameters for DEMO and coil currents, voltages and powers have been determined. Calculations of the effect of the vacuum vessel during start-up and of the out-of-plane forces on the toroidal field coils are also briefly described.

38866 (CLM-R—278, pp A4-1-A4-68) Divertor. Appendix 4. Harrison, M.F.A.; Hotston, E.S.; Thompson, V.K.; Worraker, W.J. (UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

The paper on divertors is an appendix to a study of the reactor relevance of the NET design concept. The latter study examines whether the technologies and design principles proposed for NET can be directly extrapolated to a demonstration (DEMO) reactor. The present paper examines the likely impact upon divertor performance of the relatively large fusion power of a DEMO reactor. Divertor cooling is investigated with respect to scaling of the divertor cooling system between NET and DEMO, and divertor thermohydraulics. Finally, the mechanical design of divertors is discussed, including: the selection of DEMO target design, overall

layout and magnetic geometry, liquid metal sputtering protection, stress calculations, and lifetime estimates. (U.K.).

38867 (CLM-R—278, pp A5-1-A5-40) **Relevance of NET first wall concept for DEMO DN. Appendix 5.** Kiltie, J.S. (Rolls-Royce Ltd., Derby (UK)). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

Design studies for the Next European Torus (NET) have produced a design concept for the first wall. This concept features poloidal water cooling, double contained in a welded steel structure which is protected by radiatively cooled tiles. In this appendix the relevance of this concept to a DEMO is examined with particular emphasis given to the ability of the cooling tube arrangement to remove the heat. A suggested modification to the arrangement of coolant tubes is suggested so that the design can operate at the higher loadings of a DEMO.

38868 (CLM-R—278, pp A6-1-A6-40) **Water-cooled lithium-lead blanket. Appendix 6.** Baker, L.J.; Needham, J.; Challender, R.S.; Coast, G.; Heath, E.C. (UKAEA Harwell Lab. Materials Physics and Metallurgy Div.; Progressive Engineering Consultants Ltd., Warrington (GB); UKAEA Risley Nuclear Power Development Establishment). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

The paper is an appendix to a study of the reactor relevance of the NET design concept. The present study examines whether the water-cooled lithium-lead blanket designed for NET can be directly extrapolated to a demonstration (DEMO) reactor. A fundamental requirement of the exercise is that the DEMO design should have a tritium breeding ratio which is higher than that in NET. The water-cooled lithium-lead blanket is discussed with respect to: neutronics design, design parameter survey and thermohydraulics, and engineering design. Results are reported of three-dimensional calculations using the Monte Carlo code MORSE-H to investigate possible neutron leakage between the poloidally disposed breeder tubes, and to determine the global tritium breeding ratio for the final double null machine design. (U.K.).

38869 (CLM-R—278, pp A7-1-A7-24) **Water-lead-lithium reactions. Appendix 7.** Currie, R. (UKAEA Dounreay Nuclear Power Development Establishment). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

The options of a water cooled, lead lithium eutectic breeder blanket is being considered for NET (Next European Torus). The favoured designs feature a single wall barrier between the water and the lithium-lead, therefore the possibility of breaches of this barrier with resultant chemical interactions must be considered. The purpose of this Appendix is to indicate the possible problems in the fusion reactor breeder blanket, based on the UK fast reactor experience, and to suggest further work which would allow codes, being developed to aid fast reactor designers to achieve safe and economically viable sodium heated steam generators, to be used to aid the design of the fusion blanket.

38870 (CLM-R—278, pp A8-1-A8-21) **Helium-cooled lithium-lead blanket. Appendix 8.** Baker, L.J.; Needham, J.; Challender, R.S.; Coast, G.; Hopkins, M.; Lavender, K.E. (UKAEA Harwell Lab. Materials Physics and Metallurgy Div.; Progressive Engineering Consultants Ltd., Warrington (GB); UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

In this paper the development of the Next European Torus (NET-DN) outboard liquid lithium-lead breeding blanket design to the size and performance required for a demonstration tokamak reactor (DEMO) is described. The purpose of this exercise is to show that the NET design represents a logical step in the development of a tokamak fusion power reactor; thus it was considered essential to retain both the basic geometric layout of the NET blanket and the means of access and maintenance through a nearly vertical port. However the detailed requirements of the NET and DEMO machines differ. For NET it is necessary to demonstrate in principle that tritium breeding and power generation are possible, whereas for DEMO the tritium breeding ratio (TBR) and power generation efficiency must demonstrate commercial viability.

38871 (CLM-R—278, pp A9-1-A9-39) **Tritium permeation and recovery. Appendix 9.** Bond, R.A.; Hamilton, A.M. (UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

The paper is an appendix to a study of the reactor relevance of the NET design concept. The latter study examines whether the technologies and design principles proposed for NET can be directly extrapolated to a demonstration (DEMO) reactor. In this appendix, tritium transport in the DEMO breeding blanket is considered with emphasis on the permeation rate from the lithium-lead breeder into the coolant. A computational model used to calculate the tritium transport in the breeder blanket is described. Results are reported for the tritium transport in the NET/INTOR type blanket as well as the DEMO blanket in order to provide a comparison. In addition, results are presented for the helium coolant tritium extraction analysis. (U.K.).

38872 (CLM-R—278, pp A10-1-A10-17) **Afterheat evaluation and thermal transient analysis for the water-cooled lithium-lead first wall and blanket of the DEMO version of NET. Appendix 10.** Giancarli, L.; Thompson, V.K. (UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

In the present paper, the afterheat problem is addressed for the case of the DEMO version of the water-cooled lithium-lead blanket proposed for NET. The study is divided into two major steps: the nuclear analysis, that leads to the evaluation of the amount of heat deposited in each component for various given cooling times, and the thermal transient analysis that leads to the consequent determination of the spatial and temporal variation of the temperature in the different components, depending on which accident or maintenance scenario is analysed.

38873 (CLM-R—278, pp A11-1-A11-5) **Survey of the availability of beryllium, lithium, lead and helium in the context of fusion reactor blanket design. Appendix 11.** Bond, A. (UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

The paper is an appendix to a study of the reactor relevance of the NET design concept. The appendix reviews the availability of four scarce materials, namely beryllium, lithium, lead and helium, which appear to be essential to a demonstration fusion reactor blanket based on NET design studies. For each reactor, the quantity of beryllium required is 120 tonnes, lithium is 11 tonnes and lead is 1530 tonnes. The paper concludes that there is no resource problem for these elements within the near term availability (25 years). (U.K.).

38874 (CLM-R—278, pp A12-1-A12-68) **Effect of plasma disruptions on the structural integrity of the DEMO first wall modules. Appendix 12.** Bond, R.A.; Thompson, V.K. (UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

In this paper a preliminary analysis of the stress distribution induced during a plasma disruption on the first wall modules of the DEMO reactor is presented. The main emphasis in the analysis is on the understanding of the induced current distributions and their interaction with external magnetic fields. In this respect various module models were constructed, some including the vacuum vessel, in order to ascertain the effect of various design choices on the induced electromagnetic forces. The computer code used to perform the analysis is briefly described followed by a description of the various models used to represent the first wall modules. The main results on the forces and stress distributions are presented.

38875 (CLM-R—278, pp A13-1-A13-18) **Handling and maintenance procedure for replaceable parts, (blanket modules and divertors) of DEMO-DN. Appendix 13.** Gaffka, R.C.; Hopkins, M.; Lavender, K.E.; McCarthy, C.E.A. (UKAEA Culham Lab., Abingdon). Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

The task of examining the reactor relevance of the NET-DN design must include a handling and maintenance procedure for parts which require replacement since high machine availability is an important requirement for a commercial reactor. This paper considers one certain requirement for the handling and maintenance of a DEMO-DN reactor and lists the constraints imposed by following the NET-DN design. A support and handling system for the replaceable parts (blanket modules and divertors) is described and an estimate is given for the maintenance down-time.

38876 (CLM-R—278, pp A14-1-A14-6) **Parameters of DEMO DN and JET DN. Appendix 14.** Aug 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88753508/JAW.

In Study of the reactor relevance of the NET design concept.

The paper is an appendix to a study of the reactor relevance of the NET design concept. The latter study examines whether the technologies and design principles proposed for NET can be directly extrapolated to a demonstration (DEMO) reactor. The appendix presents the parameters of the DEMO and NET under the topic headings: power, geometry, plasma, toroidal and poloidal magnetic field coils, first wall engineering, divertor physics, divertor engineering, and blanket. (U.K.).

38877 (CONF-880417—18) **Design analysis and optimization of self-cooled lithium blankets and shields.** Gohar, Y. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88010008/JAW.

From International symposium on nuclear fusion technology; Tokyo, Japan (10 Apr 1988).

A study of self-cooled lithium blankets was carried out to define the performance of these blankets and to determine the potential to operate at the maximum possible values of the performance parameters. The main design parameters considered during the course of the study were the tritium breeding ratio, the blanket energy multiplication factor, the energy fraction lost to the shield, the total blanket thickness, the reflector material selection, and the compositions of the different blanket zones. Another study was carried out to determine materials, compositions, arrangements, and thickness of the shield zone for the reference blanket. Helium and water-cooled shields were optimized for the inboard and outboard sections of the reactor. Based on the above two studies, the reference blanket and shield configurations were developed for the ANL Tokamak Power Systems Study. The helium-cooled shield was selected for use with liquid metal blankets to reduce safety concerns related to lithium-water reactivity. This helium-cooled shield provides shielding characteristics similar to a conventional water-cooled shield. The analyses and results from these studies are the subject of this paper. 12 refs., 4 figs., 2 tabs.

38878 (CONF-880512—6) **Initial operation and edge plasma studies in ATF [Advanced Toroidal Facility].** Mioduszewski, P.K.; Bell, J.D.; Bigelow, T.S.; Colchin, R.J.; Crume, E.C.; Dunlap, J.L.; Dyer, G.R.; England, A.C.; Glowienka, J.C.; Halliwell, J.W. (Oak Ridge National Lab., TN (USA); Kyoto Univ. (Japan)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011400/JAW.

From 8. international conference on plasma surface interactions in controlled fusion devices; Julich, F.R. Germany (2 May 1988).

Initial plasmas have been obtained in the Advanced Toroidal Facility (ATF) at Oak Ridge. During the first operating period all major systems worked well. Currentless plasmas have been formed with electron-cyclotron heating (ECH) and neutral beam injection (NBI). Plasma breakdown is achieved with 200 kW of microwave power using the second harmonic of the 53 GHz gyrotron at 1 T. Because of the insufficient initial cleanup state of the vessel, the density evolution during the discharge is dominated by impurity influxes due to plasma-wall interactions. Wall conditioning has so far been performed with glow discharge and electron-cylcotron resonance discharge cleaning, with the walls at room temperature. Plasma edge studies are in preparation. They are focused on experiments leading to a divertor concept for ATF. During this brief operating period, plasma conditions were dominated by wall interactions. It is expected that during the next period additional wall conditioning techniques will lead to improved plasma performances. 9 refs., 6 figs.

38879 (CONF-880613—2) **Reduced-activation austenitic stainless steels: The Fe--Mn--Cr--C system.** Klueh, R.L.; Maziasz, P.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008091/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

Nickel-free manganese-stabilized steels are being developed for fusion-reactor applications. As the first part of this effort, the austenite-stable region in the Fe--Mn--Cr--C system was determined. Results indicated that the Schaeffler diagram developed for Fe--Ni--Cr--C alloys cannot be used to predict the constituents expected for high-manganese steels. This is true because manganese is not as strong an austenite stabilizer relative to δ-ferrite formation as predicted by the diagram, but it is a stronger austenite stabilizer relative to martensite than predicted. Therefore, the austenite-stable region for Ne--Mn--Cr--C alloys occurs at lower chromium and hugher combinations of manganese and carbon than predicted by the Schaeffler diagram. Development of a manganese-stabilized stainless steel should be possible in the composition range of 20 to 25% Mn, 10 to 15% Cr, and 0.01 to 0.25%C. Tensile behavior of an Fe--20%Mn--12%Cr--0.25%C alloy was determined. The strength and ductility of this possible base composition was comparable to type 316 stainless steel in both the solution-annealed and cold-worked condition.

38880 (CONF-8710321—1) **Dosimetry and cross section measurements at RTNS II.** Greenwood, L.R.; Kneff, D.W. (Argonne National Lab., IL (USA); Rockwell International Corp., Canoga Park, CA (USA)). 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A03. Order Number DE88009972/JAW.

From Workshop on final RTNS II experiments; Monterrey, CA, USA (15 Oct 1987).

Numerous measurements have been conducted at TRNS-II in order to map the neutron field for materials irradiations, to measure activation cross sections, and to measure helium production cross sections. Experiments of up to two weeks duration irradiated large numbers of activation dosimetry and helium samples both close to the source and throughout the target room. Many other samples have been irradiated in piggy-back positions over periods lasting many months. All of these experiments fall into four main classes, namely, fluence-mapping, activation dosimetry, the production of long-lived isotopes, and helium generation measurements. Radiometric dosimetry and activation cross section measurements were performed at Argonne National Laboratory; helium production was measured at Rockwell International Corporation. This

paper briefly summarizes the principal results of our measurements at RTNS-II; references are given for more detailed publications. 14 refs., 4 figs.

38881 (CONF-8805126—1) ITER plasma equilibrium and poloidal field system design. Strickler, D.J.; Galambos, J.D.; Peng, Y.K.M. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 14p. (CONF-8805126—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011005/JAW.

From PF systems workshop; Garching, F.R. Germany (5 May 1988).

Several poloidal field coil design issues are identified when assessing the benefits of high plasma elongaton in an ITER device. Among these are the sensitivity of PF ampere-turens and coil energy to specific constraints on the plasma shape and profiles and the optimal placement of PF coils subject to assumed operating scenarios. Two versons of free boundary equilibrium codes presently under development at the Oak Ridge National Laboratory (ORNL), HEQ and VEQ, are used to solve several PF design problems related to these issues. Recent efforts have been directed toward problems in the analysis of highly elongated, magnetically-limited plasmas, such as X-point and divertor strike-point placement and control. In this report, we describe the capabilities of HEQ and discuss the major options available to the user. Applications of HEQ and VEQ in the area of plasma elongation tradeoff studies are presented. 8 refs., 4 figs., 4 tabs.

38882 (ENEA-RT-TIB—87-28) Spectral properties of undulators radiation. A numerical method. Barbini, R.; Ciocci, F.; Dattoli, G.; Torre, A.; Giannessi, L. (ENEA, Rome (Italy)). 1987. 26p. (CONF-8706192—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701806/JAW.

From Conference on undulator magnets for synchrotron radiation and free electron lasers; Trieste, Italy (23 Jun 1987).

Results are presented of a numerical code dedicated to the analysis of the spectral features of the undulator radiation. The developed numerical model includes the near-field effects, the inhomogeneous broadening due to the electron beam energy spread and emittances and the magnetic field random magnetization errors.

38883 (ENEA-RT-TIB—87-31) Linking the plasma code EDGE2D to the neutral code NIMBUS for a self consistent transport model of the boundary. De Matteis, A. (ENEA, Rome (Italy)). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702232/JAW.

This report describes the fully automatic linkage between the finite difference, two-dimensional code EDGE2D, based on the classical Braginskii partial differential equations of ion transport, and the Monte Carlo code NIMBUS, which solves the integral form of the stationary, linear Boltzmann equation for neutral transport in a plasma. The coupling has been performed for the real poloidal geometry of JET with two belt-limiters and real magnetic configurations with or without a single-null point. The new integrated system starts from the magnetic geometry computed by predictive or interpretative equilibrium codes and yields the plasma and neutrals characteristics in the edge.

38884 (GA—A19183) Infrared thermography of the DIII-D divertor targets. Baxi, C.; Ellis, R.; Ferguson, W.; Hill, D.H.; Perkins, D.E.; Petrie, T. (General Atomics Co., San Diego, CA (USA)). Feb 1988. Contract AC03-84ER51044. 13p. (CONF-880364—26). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010829/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

The power flow to the DIII-D divertor targets is routinely measured using infrared (IR) thermography. An IR television camera sensitive to radiation in the 8–12 μm range views the divertor region using a set of germanium optics. Digital signal processing is used to extract the desired surface temperature profiles from the analog data (≈20 Mbytes) stored on videotape. Inversion of these data using a simple matrix formulation of the inverse heat conduction problem then yields the incident heat flux as a function of space and time. Results from a DIII-D discharge are included. 5 refs., 4 figs.

38885 (GA—A19186) Neutral beam current driven operation of the DIII-D tokamak. Simonen, T.C.; Bhadra, D.K.; Burrell, K.H.; Callis, R.W.; Chance, M.S.; Chu, M.S.; Colleraine, A.P.; Greene, J.M.; Groebner, R.J.; Harvey, R.W.; Hill, D.N.; Kim, J.; Lao, L.; Matsuoka, M.; Petersen, P.I.; Porter, G.D.; St. John, H.; Stallard, B.W.; Stambaugh, R.D.; Strait, E.J.; Taylor, T.S. (General Atomic Co., San Diego, CA (USA)). Mar 1988. Contract W-7405-ENG-48;AC03-84ER51044;AC02-76CH03073. 10p. (CONF-880534—6). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010831/JAW.

From 15. European conference on controlled fusion and plasma heating; Dubrovnik, Yugoslavia (16 May 1988).

Neutral beam current drive experiment in the DII-D tokamak with a single null poloidal divertor are described. A plasma current of 0.34 MA has been sustained entirely by neutral beams with H-mode quality energy confinement. Poloidal beta values reach 3.5 without disruption or coherent magnetic activity, suggesting that these plasmas may be entering the second stability regime. 12 refs., 2 figs.

38886 (GA-A—18909) Recent results of divertor experiments on DIII-D. Ali Mahdavi, M.; Allen, S.; Brooks, N.H.; Content, D.; DeBoo, J.C.; Gohil, P.; Haas, G.; Heifetz, D.; Hill, D.N.; Hsieh, C.L.; Hulse, R.; Jackson, G.L.; Lao, L.; Ohyabu, N.; Perkins, S.; Perry, M.E.; Petrie, T.W.; Rensink, M.E.; Scoville, T.; Shimada, M.; Snider, R.T.; Stockdale, R.E.; Wood, R. (General Atomics Co., San Diego, CA (USA)). Jul 1987. Contract AC03-84ER51044;W-7405-ENG-48. 57p. (CONF-8707156—1). NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88007930/JAW.

From 14. session of the INTOR phase 2A workshop; Vienna, Austria (13 Jul 1987).

Results of recent experiments on DIII-D ohmic and neutral beam injection heated plasmas which provide further evidence of the role of the edge plasma on stability and confinement of the core plasma are presented. The presentation is organized into three independent sections. The first section describes the results of detailed thermography on the divertor tiles during plasma heating. Section 2 presents results of detailed electron temperature and density profile measurements. The last section is devoted to a discussion of radiation and power balance. 15 refs., 42 figs.

38887 (GA-A—19239) Overview of the TITAN-II reversed-field pinch aqueous fusion power core design. Wong, C.P.C.; Creedon, R.L.; Grotz, S.; Cheng, E.T.; Sharafat, S.; Cooke, P.I.H. (General Atomics Co., San Diego, CA (USA); California Univ., Los Angeles (USA)). Mar 1988. Contract AC03-84ER53158. 15p. (CONF-880417—6). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008170/JAW.

From International symposium on nuclear fusion technology; Tokyo, Japan (10 Apr 1988).

TITAN-II is a compact, high power density Reversed-Field Pinch fusion power reactor design based on the aqueous lithium solution fusion power core concept. The selected breeding and structural materials are $LiNO_3$ and 9-C low activation ferritic steel, respectively. TITAN-II is a viable alternative to the TITAN-I lithium self-cooled design for the Reversed-Field Pinch reactor to operate at a neutron wall loading of 18 MWm^2. Submerging the complete fusion power core and the primary loop in a large pool of cool water will minimize the probability of radioactivity release. Since the protection of the large pool integrity is the only requirement for the protection of the public, TITAN-II is a passive safety assurance design. 13 refs., 3 figs., 1 tab.

38888 (INIS-BR—1018, pp 17) Thermonuclear reactors. Reis, S.T. dos. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

38889 (JINR-R—4-87-82) Kinetics of muon catalysis processes in a deuterium-tritium mixture. 1. Quasistationary approximation. Men'shikov, L.I.; Fajfman, M.P.; Somov, L.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702931/JAW.

Submitted to the journal ZhEhTF and Organizing Comittee on International Conference Muon Catalysis - 87, Leningrad, May, 1987.

A quasistationary mode of muon catalysis in a D_3+T_3 mixture, established in the time region $t >> \lambda/sub\ eff/^{-1}$ ($\lambda/sub\ eff/^{-1}$ is the lifetime of the mesomolecule dtμ). Energy distribution functions are calculated for tμ atoms in the 1s state. The calculated spectrum of tμ mesoatoms differs from the Maxwell distribution by no more than 10 per cent. Difference between the values of the resonance dtμ production rate averaged by the calculated and Maxwell functions is 5%. 36 refs.; 6 figs.; 1 tab.

38890 (KFK—4339) Nuclear Fusion Project. Semi-annual report of the Association KfK/EURATOM. April-September 1987. Kast, G. (comp.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Dec 1987. 79p. (EUR—10539e). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753581/JAW.

Short communications give a survey of 38 technology tasks, the development of ECRH power sources at 150 GHz, and 8 NET study contracts. The fusion technology contracts and the NET contracts are listed in the appendices I and II, respectively, while the KfK departments contributing to the Fusion Project and the Fusion Project Management Staff are listed in appendices III and IV, respectively.

38891 (LA—11203-MS) Poloidal field coil stress analysis for the ZTH machine. Girrens, S.P.; Bennett, J.G.; Murphy, D.M. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 47p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88005308/JAW.

Three-dimensional finite element analysis of representative equilibrium field and ohmic heating coils for the Los Alamos ZTH air core machine was performed to determine static stress levels developed within the coil structure caused by Lorentz-force loading. Because of the complex coil configuration in cross section (copper conductors embedded in an epoxy insulating matrix), the study was performed in three steps: a bulk orthotropic material property determination, a bulk material coil section analysis, and a detailed composite cross section of selected thickness analysis. Computational procedures used with coil stress and displacement results that were obtained are presented. Extensive work was performed to investigate the magnitude of the error in coil stress predictions arising from the use of the three-step analysis procedure. Analytical and numerical procedures used to perform the estimate of error study are also presented. 34 figs.

38892 (LA-UR—88-814) Conceptual design of a reversed-field pinch fusion neutron source. Bathke, C.G.; Krakowski, R.A.; Manzanares, R.G.; Miller, R.L.; Werley, K.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 20p. (CONF-880417—5). NTIS, PC A03/MF A01; GPO Dep. Order Number TI88007895/JAW.

From International symposium on nuclear fusion technology; Tokyo, Japan (10 Apr 1988).

The conceptual design of an ohmically-heated, reversed-field pinch (RFP) operating with a 5-MWm^2 steady-state DT fusion neutron wall loading while generating {approximately}100-MW total fusion power is presented. These results are also useful in projecting the development of an economic source of DT neutrons for large-volume ({approximately}10 m^3) fusion nuclear testing. 6 refs., 4 figs., 5 tabs.

38893 (LA-UR—88-820) US team measurements during the June 1987 experimental HT release at the Chalk River Nuclear Laboratories, Ontario, Canada. Jalbert, R.A.; Murphy, C.E. (Los Alamos National Lab., NM (USA); Savannah River Lab., Aiken, SC (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880505—11). NTIS, PC A02/MF A01; GPO Dep. Order Number TI88007894/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

In June 1987, an experiment was performed at the Chalk River Nuclear Laboratories in Ontario, Canada, to study the oxidation of HT in the environment. The experiment involved a 30-minute release of 100 Ci of HT to the atmosphere at an elevation of one meter. The HTOHT ratios were shown to slowly increase downwind ({approximately}4 {times} 10/sup {minus/5} at 50 meters to almost 10/sup {minus/3 at 400 meters) as conversion of HT takes place. For several days after the release, HTO concentrations in the atmosphere remained elevated. Freeze-dried water from vegetation samples was found to be very low in HTO immediately after the release suggesting a very low direct uptake of HTO in air by vegetation. The tritiated water concentration increased during the first day, peaking during the second day (about 400 to 600 pCi/ml of water at 50 meters from the source) and decreasing by the end of the second day. The organically bound tritium continued to accumulate during the period following exposure (about 10 pCi/gm dry weight at 50 meters after two days). 4 refs., 6 figs., 2 tabs.

38894 (LA-UR—88-871) Some new techniques in tritium gas handling as applied to metal hydride synthesis. Nasise, J.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-880505—12). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007839/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

A state-of-the-art tritium Hydriding Synthesis System (HSS) was designed and built to replace the existing system within the Tritium Salt Facility (TSF) at the Los Alamos National Laboratory. This new hydriding system utilizes unique fast-cycling 7.9 mole uranium beds (47.5g of T at 100% loading) and novel gas circulating hydriding furnaces. Tritium system components discussed include fast-cycling uranium beds, circulating gas hydriding furnaces, valves, storage volumes, manifolds, gas transfer pumps, and graphic display and control consoles. Many of the tritium handling and processing techniques incorporated into this system are directly applicable to today's fusion fuel loops. 12 refs., 7 figs.

38895 (ORNL/TM—10572) Compact torsatron reactors. Lyon, J.F.; Carreras, B.A.; Lynch, V.E.; Tolliver, J.S.; Sviatoslavsky, I.N. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 49p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010755/JAW.

Low-aspect-ratio torsatron configurations could lead to compact stellarator reactors with R_0 = 8–11m, roughly one-half to one-third the size of more conventional stellarator reactor designs. Minimum-size torsatron reactors are found using various assumptions. Their size is relatively insensitive to the choice of the conductor parameters and depends mostly on geometrical constraints. The smallest size is obtained by eliminating the tritium breeding blanket under the helical winding on the inboard side and by reducing the radial depth of the superconducting coil. Engineering design issues and reactor performance are examined for three examples to illustrate the feasibility of this approach for compact reactors and for a medium-size ($R_0 \simeq$ 4 m,{bar a} {approx<~lt} 1 m) copper-coil ignition experiment. 26 refs., 11 figs., 7 tabs.

38896 (PPPL—2523) Tritium retention in TFTR. Dylla, H.F.; Wilson, K.L. (eds.). (Princeton Univ., NJ (USA). Plasma Physics Lab.; Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC02-76CH03073;AC04-76DP00789. 130p. (SAND—88-8212). NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88011877/JAW.

This report discusses the materials physics related to D-T operation in TFTR. Research activities are described pertaining to

basic studies of hydrogenic retention in graphite, hydrogen recycling phenomena, first-wall and limiter conditioning, surface analysis of TFTR first-wall components, and estimates of the tritium inventory.

38897 **(SAND—87-2716) A model for diffusion in the tokamak edge and application to the modular pump limiters on Tore Supra.** McGrath, R.T. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010154/JAW.

The relative positioning of the limiter modules on Tore Supra is investigated with the objective of optimizing the overall performance of the system and the operational flexibility of the experiment. Working within the constraints imposed by the availability of ports on Tore Supra, the best limiter configuration for a system of seven modular limiters is identified. The performance to be expected for this optimized configuration for various modes of Tore Supra operation is reported. We find that very long flux tubes must be avoided if the limiter system is to operate near its full design capacity of 8.0 MW. For the assumed edge conditions, as discussed in the text, Bohm diffusion with a plasma temperature of 150 eV at the last closed flux surface, the configuration identified can exhaust between 17--21 torr{minus}1/s while removing 5--8 MW of power incident on the limiter surfaces. Operational modes that pump as much as 26 torr{minus}1/s are also possible if incident power levels are reduced to 4.0 MW. Operation with large amounts of auxiliary heating, in excess of 15 MW, is also possible by power sharing with the actively cooled inner bumper limiter. In this situation particle pumping rates may be as low as 9 torr{minus}1/s. 19 refs., 11 figs., 1 tab.

38898 **(SAND—88-0764) Target designs for plasma-implosion-driven, photoionization-pumped soft x-ray lasers.** Hussey, T.W.; Matzen, M.K.; McGuire, E.J.; Dalhed, H.E. (Sandia National Labs., Albuquerque, NM (USA); Lawrence Livermore National Lab., CA (USA)). May 1988. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011278/JAW.

Designs are proposed for layered, hollow cylindrical targets to be placed on the axis of an imploding, hollow Z-pinch plasma that can create the approximate plasma conditions, as well as radiation spectrum, for a photoionization pumped, Ne-like recombination laser. The lasant must research the Ne-like state and be at the appropriate density concurrent with the photoionizing pump radiation. This places severe constraints on designs for such targets with the vertical vacuum feed diode on Proto 2. Target designs are further constrained by the fact that the 3s--2p resonance line, which depopulates the lower lasing state, must not be highly trapped and by the fact that the upper lasing state must not be collisionally depopulated. We find that hollow, cylindrical targets consisting of a few micron CH strongback, coated on the inside with a thin layer of Ni lasant and on the outside with an Al converter layer, can be optimized to acheive appropriate conditions for lasing. We note that a trade-off exists between larger targets, which better isolate the target from the shock of stagnation, and smaller targets, which deliver a higher intensity pump flux. We also find that trapping, together with uncertainties in the inward expansion of the lasant layer, are significant, and may limit optium available gain. 30 refs., 22 figs., 1 tab.

38899 **(SAND—88-1072) Proceedings of U.S.-Japan workshop Q86 on plasma-materials interaction/high heat flux data needs for the next step and steady state devices.** Whitley, J. B.; Miyahara, A. (eds.). (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 510p. (CONF-8803111—). NTIS, PC A22;3. Order Number DE88011539/JAW.

From U.S.-Japan workshop Q86 on plasma-materials interaction/high heat flux data needs for the next step and steady state devices; Albuquerque, NM, USA (7 Mar 1988).

This workshop was the third in a series carried out as part of the US-Japan Fusion Cooperation Program. The primary objective of this workshop was to complete the assessment of data on graphite that was begun earlier. A second objective was to assemble the data on graphite in such a way as to serve as a basis with which to compare the features of other candidate materials. Finally, an attempt was made to summarize relevant engineering experience to provide guidelines for component design. The talks are grouped into four broad categories: plasma-materials interactions, neutron effects, hight heat flux phenomena, and engineering issues. Working groups for each of these areas discussed the current status and provided summaries of research. The individual papers in this report vary in format. A great deal of the data is preliminary in nature. Some researchers have included formal discussions of their research, but most of the material in this document are reproductions of slides and viewgraphs presented at the meeting with little explanatory text. (DWL)

38900 **(TRITA-PFU—86-10) Studies of the transformer core performance for a toroidal Extrap Z-pinch discharge experiment.** Bures, M.; Drake, J.R.; Eninger, J.E. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Oct 1986. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752502/JAW.

Extrap is the collective name given to a series of Z-pinch discharge experiments which are distinguished by the fact that the cross-section of the discharge current channel is non-circular. The Extrap toroidal discharge is driven as the secondary of a pulse transformer circuit which has a characteristic operational frequency of about 20 kHz. The key component in this circuit is a high permeability transformer core. Three test core segments have been studied under conditions similar to those of the Extrap experiments. All of the cores were wound using thin, 50-mm wide band with a build of 200 mm and the magnetic length of the cores is about 3 m. Two of the test cores were manufactured from 0.051-mm Si-Fe band while the third was manufactured from 0.025-mm metallic glass band. For all the cores, the measured flux swings at 20 kHz operation are close to values corresponding to the DC saturation permeabilities of the respective materials. In addition, one of the cores has been used on the toroidal Extrap experiment in studies of toroidal discharge breakdown and current build-up under Extrap conditions. Loop voltages of up to 4.5kV were applied and current rates of rise of up to 2x10/sup9/ As/sup-1/ have been achieved. (authors).

38901 **(TRITA-PFU—87-01) Bootstrap states of the Z-pinch.** Lehnert, B. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Jan 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752505/JAW.

Steady bootstrap states of a Z-pinch are investigated both in absence and in presence of an imposed axial magnetic field, in terms of MHD theory with classical resistivity. The results indicate that bootstrap operation should become possible for certain classes of plasma profiles and that such operation can lead to higher bootstrap currents in a Z-pinch without axial magnetic field than in a tokamak-like case under similar plasma conditions. The ratio between the latter and the former currents is of the order of the square root of the beta value in the tokamak-like case. A simple numerical example is given on boot-strap operation in the Z-pinch. Neoclassical or anomalous diffusion will increase the diffusion velocity of the plasma but are not expected to affect the main physical features of the present results. This applies also to the kinetic effects in the weak-field region near the axis of the Z-pinch, because these effects can largely be described by MHD-like equations for a steady equilibrium. Bootstrap operation and the technical difficulty in realizing a volume distribution of particle sinks introduce certain constraints on the plasma and current profiles. This has to be taken into account in a stability analysis. The latter cannot only be performed in terms of MHD-like theory but has to be based on kinetic theory including large Larmor radius (LLR) effects.

38902 **(UCRL—96655) Plans for the CIT [Compact Ignition Tokamak] instrumentation and control system.** Preckshot, G.G. (Lawrence Livermore National Lab., CA (USA)). 7 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—100). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011323/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Extensive experience with previous fusion experiments (TFTR, MFTF-B and others) is driving the design of the Instrumentation and Control System (I and C) for the Compact Ignition Tokamak (CIT) to be built at Princeton. The new design will reuse much equipment from TFTR and will be subdivided into six major parts: machine control, machine data acquisition, plasma diagnostic instrument control and instrument data acquisition, the database, shot sequencing and safety interlocks. In a major departure from previous fusion experiment control systems, the CIT machine control system will be a commercial process control system. Since the machine control system will be purchased as a completely functional product, we will be able to concentrate development manpower in plasma diagnostic instrument control, data acquisition, data processing and analysis, and database systems. We will discuss the issues driving the design, give a design overview and state the requirements upon any prospective commercial process control system.

38903 (UCRL—97379) Reactor applications of the compact fusion advanced Rankine (CFAR) cycle for a D-T tokamak fusion reactor. Hoffman, H.A.; Logan, B.G.; Campbell, R.B. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 17p. (CONF-880417—21). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011351/JAW.

From International symposium on nuclear fusion technology; Tokyo, Japan (10 Apr 1988).

We have made a preliminary design of a D-T fusion reactor blanket and MHD power conversion system based on the CFAR concept, and found that the performance and costs for the reference cycle are very attractive. While much remains to be done, the potential advantage of liquid metal Rankine cycles for fusion applications are much clearer now. These include low pressures and mass flow rates, a nearly isothermal module shell which minimizes problems of thermal distortion and stresses, and an insensitivity to pressure losses in the blanket so that the two-phase MHD pressure drops in the boilling part of the blanket and the ordinary vapor pressure drops in the pebble-bed superheating zones are acceptable (the direct result of pumping a liquid rather than having to compress a gas). There are no moving parts in the high-temperature MHD power generators, no steam bottoming plant is required, only small vapor precoolers and condensers are needed because of the high heat rejection trmperatures, and only a relatively small natural-draft heat exhanger is required to reject the heat to the atmosphere. The net result is a very compact fusion reactor and power conversion system which fit entirely inside an 18 meter radius reactor vault. Although we have not yet performed a detailed cost analysis, preliminary cost estimates indicate low capital costs and a very attractive cost of electricity. 11 refs., 5 figs., 2 tabs.

38904 (UCRL—97520) A new box system for a high pressure tritium pump. Wilson, S.W.; Borree, R.J.; Chambers, D.I.; Souers, P.C.; Merrill, J.T.; Wiggins, R.K. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 15p. (CONF-880505—22). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011334/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

A 200 MPa (30 kpsi) high pressure tritium pump inside a box system is described. This system is currently under construction but all representative mechanical parts have been fabricated and tested. The pump is a conventional mechanical-plus-cryostaged system, so that most of the interesting features are in the box. The system contains nine separate sections, with automatic pressure balancing and venting systems. Five sections are hood-to-box convertible enclosures with inflatable door seals. The procedure of cryostaging with liquid argon is described. Special detail is given to valves and motor shaft seals. 3 refs., 4 figs.

38905 (UCRL—98419) Four-frame gated optical imager with 120-ps resolution. Young, P.E.; Hares, J.D.; Kilkenny, J.D.; Phillion, D.W.; Campbell, E.M. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 20p. (CONF-880364—30). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011735/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

In this paper we describe the operation and applications of a framing camera capable of four separate two-dimensional images with each frame having a 120-ps gate width. Fast gating of a single frame is accomplished by using a wafer image intensifier tube in which the cathode is capacitively coupled to an external electrode placed outside of the photocathode of the tube. This electrode is then pulsed relative to the microchannel plate by a narrow (120 ps), high-voltage pulse. Multiple frames are obtained by using multiple gated tubes which share a single bias supply and pulser with relative gate times selected by the cable lengths between the tubes and the pulser. A beamsplitter system has been constructed which produces a separate image for each tube from a single scene. Applications of the framing camera to inertial confinement fusion experiments are discussed.

38906 (UWFDM—686) SIRIUS-M: A symmetric illumination, inertially confined direct drive materials test facility. Abdel-Khalik, S.I.; Attaya, H.; Engelstad, R.L.; Kulcinski, G.L.; Liang, J.H.; Lovell, E.G. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.). Apr 1986. Contract AS08-86DP10529. 27p. (CONF-860421—82). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008059/JAW.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

SIRIUS-M is a fusion materials test facility designed to duplicate the time-dependent radiation damage structure unique to ICF systems in order to provide the technology base necessary for an ICF demonstration facility. Single-shell ICF targets are symmetrically illuminated by 32 beams of a KrF laser with a total laser energy of 1 MJ. A wall loading of 2 MWm^2 is achieved at a repetition rate of 10 Hz and target gain of 13.4. Xenon gas at a pressure of 133 Pa (1 torr) is placed in the 2 m radius, graphite-tiled cavity in order to protect the first wall from the x-rays and ions produced by the explosions. Two circular test modules are used in SIRIUS-M. Each module has a front surface area of 1 m^2 and fits between three beam ports. No significant radial and azimuthal damage variation in the module results from these penetrations. The peak dpa rate is 24 dpaFPY yielding a peak accumulated damage of 120 dpa at the end of life of the SIRIUS-M facility. A total volume-integrated-damage figure of merit of 2840 dpa-{ell} per full power year can be achieved in SIRIUS-M. 14 refs., 8 figs., 2 tabs.

38907 Low-density resorcinol—formaldehyde aerogels for direct-drive laser inertial confinement fusion targets. Hair, L.M.; Pekala, R.W.; Stone, R.E.; Chen, C.; Buckley, S.R. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 4, 2559-2563(Jul 1988).

Resorcinol—formaldehyde (RF) aerogels satisfy inertial confinement fusion requirements for cell size and density. The cell size is <0.1 μm for densities ranging from 65 to 100 mg/cm^3. Uniformity as measured by x-ray radiography appears good, but careful machining of the RF piece is needed to prevent machine marks from interfering with interpretation. The RF aerogel is wettable with liquid hydrogen, and can be machined to 7-μm surface finish. Stability of that surface over time needs to be improved. Radiation stability, methods of gluing and overcoating, and the thermal expansion coefficient still need to be determined.

38908 Mode conversion and absorption of lower hybrid waves in inhomogeneous magnetic fields. Cho, S.; Swanson, D.G. (Department of Physics, Auburn University, Auburn, Alabama 36849). *Physics of Fluids;* 31: No. 7, 1968-1978(Jul 1988).

When a cold lower hybrid wave propagates in an inhomogeneous plasma, it undergoes a total mode conversion to the warm wave which is then coupled with the ion Bernstein wave around ion cyclotron harmonic frequencies. Both types of linear mode conversion problems can be described by fourth-order differential equations if the two processes are separated from each other. The combination of the two types of mode conversion when the lower hybrid turning point is in the vicinity of a cyclotron harmonic re-

quires a sixth-order equation with a quadratic coefficient, which is not solvable analytically nor numerically. Another type of sixth-order equation, which has only linear coefficients and represents the three-wave problem marginally, is solved analytically without including the absorption term. Finally, the damping and the absorption of the wave are compared for the unmagnetized dispersion relation, the full magnetized dispersion relation, and the mode conversion analysis as the wave propagates in a magnetically confined plasma with slab geometry.

38909 **Vacuum-assisted contaminated-particulate removal.** Watson, W. (Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14623-1299). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 4, 2568-2570(Jul 1988).

In many research projects, experiments are conducted which involve chemical radiological contamination of microscopic particulate matter in vacuum chambers. Inertial confinement fusion experiments, for example, often result in a residue of radioactive particulate matter on a scale of microns on the inside of the vacuum vessel. Removal of this particulate matter would present hazards to personnel. This paper describes a method of removal of this particulate matter using a vacuum containment vessel and filtration medium which limits personnel exposure.

38910 **Fusion power monitor.** Pettus, W.G.; Warren, H.D. (to Babcock and Wilcox Co., New Orleans, LA). US Patent 4,735,763. 5 Apr 1988. Filed date 13 Oct 1981. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A power monitoring system for a fusion reactor of the type having a plasma region contained within a vacuum vessel by a magnetic field is described comprising: radiation detection means; an activation medium; and circulation means for circulating the activation medium by the vacuum vessel and by the radiation detection means wherein the circulation means includes a feed tube penetrating the fusion reactor to the vacuum vessel, a loop tube fed by the feed tube and passing over the vacuum vessel wherein the activation fluid is activated, and a return tube fed by the loop tube and extending out of the fusion reactor and to the radiation detection means.

38911 **Flexible helical-axis stellarator.** Harris, J.H.; Hender, T.C.; Carreras, B.A.; Cantrell, J.L.; Morris, R.N. (to Dept. of Energy, Washington, DC). US Patent 4,735,765. 5 Apr 1988. Filed date 26 Nov 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In a helical-axis stellarator of the type including a planar circular central winding, a planar toroidal magnetic field generating coils disposed about the central winding whose centers are located on a helical axis twisting about and spaced from the central winding to form a toroidal helix having M toroidal periods in which a helical axis plasma is magnetically confined, the improvement is described comprising: an l=1 helical winding, where l is the toroidal winding multiplicity, disposed to spiral about and encompass the planar circular central winding one revolution for each period of the toroidal helix in close proximity to the central winding and in phase with the helical axis of the plurality of toroidal magnetic field generating coils so that currents in the helical winding and the central winding may be separately varied to contain the rotational transform, tau, of closed magnetic flux surfaces which confine the helical axis plasma for stably confining the plasma at finite beta values. The helical winding include separate winding layers disposed radially outward from the central winding so that separate currents may be applied to the separate layers of the l=1 helical winding to effectively vary the radial space relationship of the effective center of the l-1 helical winding relative to the central winding thereby varying the shear of the magnetic flux surfaces.

38912 **Laser or charged-particle-beam fusion reactor with direct electric generation by magnetic flux compression.** Lasche, G.P. (to Dept. of Energy, Washington, DC). US Patent 4,735,762. 5 Apr 1988. Filed date 20 Feb 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for recovering energy in an inertial confinement fusion reactor having a reactor chamber and a sphere forming means positioned above an opening in the reactor chamber is described, comprising: embedding a fusion target fuel capsule having a predetermined yield in the center of a hollow solid lithium tube and subsequently embedding the hollow solid lithium tube in a liquid lithium medium; using the sphere forming means for forming the liquid lithium into a spherical shaped liquid lithium mass having a diameter smaller than the length of the hollow solid lithium tube with the hollow solid lithium tube being positioned along a diameter of the spherical shaped mass, providing the spherical shaped liquid lithium mass with the fusion fuel target capsule and hollow solid lithium tube therein as a freestanding liquid lithium shaped spherical shaped mass without any external means for maintaining the spherical shape by dropping the liquid lithium spherical shaped mass from the sphere forming means into the reactor chamber; producing a magnetic field in the reactor chamber; imploding the target capsule in the reactor chamber to produce fusion energy; absorbing fusion energy in the liquid lithium spherical shaped mass to convert substantially all the fusion energy to shock induced kinetic energy of the liquid lithium spherical shaped mass which expands the liquid lithium spherical shaped mass; and compressing the magnetic field by expansion of the liquid lithium spherical shaped mass and recovering useful energy.

38913 **A novel non-power-producing fusion-fission breeder reactor.** Wrisley, K.L.; Steiner, D. (Rensselaer Polytechnic Institute, Dept. of Nuclear Engineering and Engineering Physics, Fusion Engineering Program, Troy, NY (US)). *Fusion Technology;* 13: No. 3, 453-462(Mar 1988).

One of the potentially attractive applications of nuclear fusion is to breed fissile fuel for use in fission reactors. A fusion-fission breeder is examined, based on four unique concepts: operations in a non-power-producing mode, a low technology (low pressure and temperature) aqueous self-cooled blanket for breeding fissile fuel, the spherical torus confinement scheme (low-aspect-ratio tokamak), and the catalyzed deuterium-deuterium (D-D) fuel cycle. The breeding of fissile fuel is accomplished by dissolving a uranium salt, i.e., uranyl nitrate, in heavy water that cools both the first wall and blanket. The use of the catalyzed D-D fuel cycle eliminates the need for tritium breeding. The neutron wall loading for this reactor is only —0.5 MW/m/sup 2/, and the fusion power output is —1000 MW(thermal). Analysis of this novel reactor concept indicates a fissile breeding ratio of 1.34 fissile atom/source neutron using a 15-cm beryllium moderator/multiplier region and 7 mol% uranyl nitrate in the heavy water. A typical reactor using this blanket can produce more than 7400 kg of plutonium per operating year. This concept can provide fissile fuel at a cost that is comparable to previous fusion breeder designs but at a capital cost of about one-third that of the previous designs.

38914 **Problems in modeling toroidal field ripple loss of fast alphas from a tokamak reactor.** Hively, L.M. (Oak Ridge National Lab., Oak Ridge, TN (US)). *Fusion Technology;* 13: No. 3, 438-446(Mar 1988).

The present status of modeling toroidal field (TF) ripple loss of fast alphas from tokamaks is summarized. The modeling issues are discussed, and several new aspect of this problem are described, including gyromotion, radial electric field, and sawtoothing. Existing models predict that TF ripple loss of fast alphas will have a low to moderate impact on the design of a tokamak engineering test reactor.

38915 **Heavy-ion linear induction accelerators as drivers for inertial fusion power plants.** Hovingh, J.; Brady, V.O.; Faltens, A.; Keefe, D.; Lee, E.P. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA (US)). *Fusion Technology;* 13: No. 2, 255-278(Feb 1988).

A linear induction accelerator that produces a beam of energetic heavy ions (T — 10 GeV, A — 200 amu) is a prime candidate as a driver for an inertial fusion power plant. Some early perceptions were that heavy-ion drive fusion would not be cost-competitive with other power sources because of the high cost of the accelerators. However, improved understanding of the physics of heavy-ion transport and acceleration (supported by experimental results), combined with advances in accelerator technology, have resulted in accelerator design costs — 50% of previous estimates. As a result,

heavy-ion drive fusion power plants are now projected to be cost-competitive with other conceptual fusion power plants. A brief formulation of transport and acceleration physics is presented here, along with a description of the induction Linac cost optimization code LIACEP. Cost trends are presented and discussed, along with specific cost estimates for several accelerator designs matched to specific inertial fusion target yields. Finally, a cost-effective strategy using heavy-ion induction Linacs in a development scenario for inertial fusion is presented.

38916 **Concept of a blanket first wall supported by radial tubes.** Moir, R.W. (Lawrence Livermore National Lab., CA (USA)). *Fusion Engineering and Design;* **5**: No. 4, 379-383(Jan 1988). Contract W-7405-ENG-48.

This paper describes a new idea for the design of the first wall of a fusion reactor blanket. Radially oriented tubes are used to support the first wall and to channel coolant to the front of the blanket. A metal skin resembling a tufted or quilted seat cushion is supported in pure tension by the tubes. This thin skin, which forms the first wall, can contain the internal pressure of the blanket and yet be reasonably transparent to neutrons. The structural volume fraction is the minimum theoretically required, thus further enhancing neutron economy. Another advantage is the openness of the blanket interior, giving the blanket designer considerable freedom. The design appears to be resistant to radiation damage.

38917 **Multiplex Tokamak power plant.** Dabiri, A.E. (Science Applications International Corp., 11526 Sorrento Valley Road, San Diego, CA (US)). *Fusion Technology;* **13**: No. 1, 115-124(Jan 1988).

The concept of multiplexing for a fusion power core as an option for producing power is explored. Superconducting, as well as normal magnet, coils in either first or second stability regimes are considered. The results show that multiplex plants with superconducting magnets operating in the second stability regime could be competitive with the single-unit plants in some unit sizes. The key issues that impact the expected benefits of multiplexing must be investigated further. These are factory fabrication, economy of scale, the extent of equipment sharing, inherent safety, maintainability, and utility load management.

38918 **Tokamak Fusion Test Reactor central ignition scenarios.** Redi, M.H.; Zweben, S.J.; Bateman, G. (Princeton Univ., Plasma Physics Lab., Princeton, NJ (US)). *Fusion Technology;* **13**: No. 1, 57-86(Jan 1988).

The possibility of obtaining ignition in the Tokamak Fusion Test Reactor (TFTR) by means of very centrally peaked density profiles is examined. It is shown that local central alpha heating can be made to exceed local central energy losses ("central ignition") under global conditions for which $Q \geq 1$. Time-dependent one-dimensional transport simulations with a simplified transport model show that the normal global ignition requirements are substantially relaxed for plasmas wi*th peaked density profiles. More realistic simulations with recently developed profile-consistent microinstability based models for electron and ion confinement show that TFTR may form a small centrally ignited region if peaked central density can be maintained.

38919 **(DOE-tr—88-11) Summary of national programs: Main points of Japanese policy proposal.** (USDOE, Washington, DC). 1988. Translation source information not available. 6p. NTIS, PC A02;3.

This paper briefly discusses Japan's plans to develop thermonuclear energy and research already underway. (LSP)

38920 **Assessment of eddy current effects on compression experiments in the Tokamak Fusion Test Reactor.** Wong, K.L.; Park, W. (Princeton Plasma Physics Lab., Princeton Univ., James Forrestal Campus, P.O. Box 451, Princeton, NJ 08544 (US)). *Fusion Technology;* **12**: No. 3, 437-443(Nov 1987). Contract AC02-76CH03073.

The eddy current induced on the Tokamak Fusion Test Reactor vacuum vessel during compression experiments is estimated based on a cylindrical model. It produces an error magnetic field that generates magnetic islands at the rational magnetic surface. The widths of these islands are calculated and found to have some effect on electron energy confinement. However, resistive magnetohydrodynamic simulation results indicate that the island formation process can be slowed by plasma rotation.

38921 **Environmental effects of fusion power plants. Part II: Tritium effluents.** Watson, J.S.; Easterly, C.E.; Cannon, J.B.; Talbot, J.B. (Oak Ridge National Lab., Fusion Environmental Program, P.O. Box X, Oak Ridge, TN 37831 (US)). *Fusion Technology;* **12**: No. 3, 354-363(Nov 1987). Contract AC05-84OR21400.

Tritium releases from fusion reactors were estimated for normal (nonaccident) operating conditions. The STARFIRE reactor design was used as a reference case, but the effects of alternate design choices and conditions were also addressed. Potential environmental losses were examined for each of the major tritium handling systems. Estimates of —20 Ci/day were made for the 1000-MW (electric) reactor, with approximately equal portions coming from the gas handling systems (plasma, vacuum, and fuel systems) and from the coolant system.

38922 **Environmental effects of fusion power plants. Part I: Effluents other than tritium.** Cannon, J.B.; Easterly, C.E.; Davis, W. Jr.; Watson, J.S. (Oak Ridge National Lab., Fusion Environmental Program, Oak Ridge, TN 37831 (US)). *Fusion Technology;* **12**: No. 3, 341-353(Nov 1987). Contract AC05-84OR21400.

Radioactive and nonradioactive effluents are released routinely during normal operation of near-term commercial fusion power reactors. Nonradioactive effluents are essentially the same as those released at conventional steam-electric power plants. Radioactive effluents consist of activated corrosion products and tritium. Most radioactive releases originate from liquid-waste processing systems and from ventilation systems of various buildings where radioactivity may become airborne. These effluents have some potential for environmental impact; however, the significance of the impact depends in part on the concentration and release rate of the effluent. The type of reactor design (e.g., tokamak, mirror, etc.) has minimal influence on activation product releases. Activation products released are influenced primarily by the materials chosen for structural components, and the quantities released are influenced primarily by the coolant choice.

38923 **Hydrogen recycling properties of graphite.** Wilson, K.L.; Hsu, W.L. (Sandia National Labs., Livermore, CA (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—).

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

A review is presented on the hydrogen recycle properties of graphite, the leading, candidate material for plasma interactive component surfaces. The hydrogen transport database and modelling are summarized, followed by a discussion of its recycling properties in operating devices and its predicted tritium retention behavior in future D-T reactors.

38924 **Plasma-driven permeation of deuterium in nickel.** Causey, R.A.; Baskes, M.I. (Sandia National Labs., Livermore, CA (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—).

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The Tritium Plasma Experiment has been used to measure the temperature dependence of the plasma-driven permeation of 100 eV deuterium through nickel. Experiments were performed over the temperature range 473 K to 773 K with fluxes on the order of $3 \times 10^{16} Dcm^{2}$-s. In contrast to other recently reported data for hydrogen isotopes in nickel, the permeation rate agreed with that expected from the Baskes model for the surface recombination rate coefficient. The validity of this model is discussed. In-situ surface analysis by Auger electron spectrometry was used to measure the surface contamination during the plasma exposure. Measurements for two samples with different amounts of carbon on the surface gave similar permeation rates, suggesting that surface carbon does

not significantly affect the deuterium surface recombination rate for nickel.

38925 Influence of displacement damage on deuterium permeation in 316 stainless steel. Doyle, B.L.; Brice, D.K. (Sandia National Labs., Albuquerque, NM (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC04-76DP00789.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

A new permeation system for in situ measurements of the effect of radiation damage on both gas and plasma-driven hydrogen permeation through metal foils has been developed. The source of displacement damage was a beam of 16 MeV carbon ions whose range was significantly greater than the 4 μm foil thickness. Initial ion-driven deuterium permeation results for 316 stainless steel show no evidence for radiation-enhanced effects for temperatures in the range 200-400°C and displacement damage rates of 0.5 dpaday. An upper limit for the radiation enhancement of the diffusion coefficient of 100%(dpaday) has been established. Good agreement between this data and a transport parameter calculation modified to handle gases has been obtained.

38926 Dependence of the hydrogen concentration in metals on the surface impurities. Pick, M.A. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC02-76CH00016.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

In a recent paper we have shown that there is a difference in the concentration of hydrogen set up in a metal when it is exposed to a flux of atomic hydrogen as compared to the same flux of molecular hydrogen. Whereas in the case of molecular hydrogen one reaches an equilibrium situation in which the resulting concentration is a bulk property given by Sievert's law totally independent of the condition of the surface, in the case of an atomic flux the resulting steady state concentration becomes a surface dependent property governed to a large extent by the condition of the surface and the resulting surface potentials. In this paper I extend the model to the more realistic case of energetic hydrogen atoms which are implanted into the metal and discuss the consequences. Furthermore, I compare the interaction of the plasma with metals to electrolytic hydrogen charging and point out the similarities. Also in this case, due to surface impurity layers, one obtains high concentrations of hydrogen.

38927 Surface-limited release of deuterium from iron. Wampler, W.R. (Sandia National Labs., Albuquerque, NM (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC04-76DP00789.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The release of deuterium (D) from solution in iron was measured for conditions approaching a bare-metal surface on single crystal and polycrystalline samples sputter-cleaned in UHV. The release rate was found to be proportional to the square of the concentration of D in solution. The second-order kinetics show the release is limited by molecular recombination of D on the surface. The recombination coefficient (K) measured for clean surfaces can be described by K = K_o exp(Q/sub K/kT) with K_o = 10^{-21} cm^4s and Q/sub K/ = (0.69+-0.06) eV. These recombination coefficients are orders of magnitude larger than those previously reported for iron. A model for K is presented in which the rate limiting step is the recombination and desorption of D chemisorbed on the surface and which agrees closely with the measured values. Controlled dosing of the samples with oxygen showed that submonolayer oxygen coverages cause large reductions in the D release rate.

38928 Trapping of deuterium in oxygen-implanted aluminum. Myers, S.M.; Follstaedt, D.M. (Sandia National Labs., Albuquerque, NM (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC04-76DP00789.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Temperature-ramp experiments employing nuclear-reaction analysis have shown that deuterium (D) is strongly trapped by Al_2O_3 precipitates in O-implanted Al. Binding enthalpies of approximately 0.7 and 1.2 eV relative to the solution site were obtained for the oxide-associated traps, as compared to 0.5 eV for defect traps within the metal matrix. The 0.7 eV trapping is hypothesized to result from the formation of D_2 molecules at the oxide boundaries and possibly within the oxides, whereas the 1.2 eV interaction is tentatively attributed to O-D bonding. Strong trapping of hydrogen isotopes by oxides within Al and possibly other metals has significant implications for plasma-materials interaction in fusion reactors.

38929 Calculated particle inventories in the TFTR moveable limiter and first wall. Heifetz, D.B.; Dylla, H.F.; Baskes, M.I.; Ulrickson, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Sandia National Labs., Livermore, CA (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC02-76CH03073.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

A model for the time evolution of the particle inventories within the device components of TFTR has been developed. The DIFFUSE code is used to calculate the one-dimensional diffusion and trapping of particles in the wall and limiters. The DEGAS neutral transport code computes the charge-exchange fluxes onto these components. This combined model will be useful in determining the concentrations of isotopes in the device components, overall pumping by the wall and limiter during discharges, degassing rates between discharges, and the rate of isotope exchange in the machine. Example results for a 1.4 MA, 80 cm, ohmically heated discharge shaped by the TFTR moveable limiter are given. One preliminary finding was that the hydrogen inventory in the wall is comparable to that in the limiter. A bound on the diffusivity of hydrogen in graphite was also suggested by these calculations. Pumping of this discharge by the Zr/Al getter system was also simulated, and was found to be negligible.

38930 Dynamical calculation of low energy hydrogen reemission off hydrogen covered surfaces. Baskes, M.I.; Foiles, S.M.; Melius, C.F. (Sandia National Labs., Livermore, CA (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—).

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The reemission of low energy (< 100 eV) hydrogen is a critical issue on plasma/first wall recycling. Previous molecular dynamics calculations, using the Embedded Atom Method (EAM), showed a decreasing reflection coefficient at energies below 10 eV for clean nickel surfaces with no surface defects. These calculations have been extended to investigate the influence of chemisorbed hydrogen atoms on the reemission coefficient for typical fusion operating conditions. A hybrid EAM method has been developed to include molecular hydrogen formation. The results of these calculations indicate that, in addition to atomic reflection and atomic penetration into the bulk which occur on a clean surface, hydrogen atom induced atomic and molecular desorption can compete, thereby affecting the reemission coefficient. The results are dependent on the incident hydrogen energy as well as surface coverage.

38931 Permeation of deuterium implanted into V-15Cr-5Ti. Anderl, R.A.; Longhurst, G.R.; Struttmann, D.A. (Idaho National Engineering Lab., Idaho Falls (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC07-76ID01570.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Permeation and reemission of deuterium for the vanadium alloy, V-15Cr-5Ti, was investigated using 3 keV, D_3^+ ion beams from a small accelerator. The experiments consisted of measure-

ment of the deuterium reemission and permeation rates as a function of implantation fluence for 0.5 mm thick specimens heated to temperatures from 623 K to 823 K. Implantation-side surface characterization was made by simultaneous measurements of sputtered ions with a secondary ion mass spectrometer (SIMS). For the experimental conditions used, the steady-state deuterium permeation flux in V-15Cr-5Ti is approximately 18% of the implantation flux. This is approximately 1000 times that seen in the austenitic stainless steel, PCA, and 200 times that seen in the ferritic steel, HT-9, under comparable conditions. Measurement of deuterium diffusivity in V-15Cr-5Ti using permeation break-through times indicates that $D = 1.4 \times 10^{-8} \exp(-0.11 \text{ eV}kT)(m^2/s)$, over the temperature range 723 K to 823 K.

38932 Residual effects of chromium gettering on the outgassing behavior of a stainless steel vacuum vessel. Simpkins, J.E.; Blanchard, W.R.; Dylla, H.F.; LaMarche, P.H. (Oak Ridge National Lab., TN (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC02-76CH03073;AC05-84OR21400.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Long-lasting beneficial effects on plasmas after chromium gettering have been observed in ISX and TFTR. These benefits include a reduction in radiated power, lower Z/sub eff/, and the capability to operate at higher densities. This paper reports laboratory experiments performed to further investigate the underlying mechanism for this enhanced plasma performance. A stainless steel vacuum vessel and a chromium sublimation source were assembled to simulate the arrangement in TFTR. A controlled air leak was introduced, and the residual gases were monitored by a quadrupole mass spectrometer before, during, and after the deposition of a chromium film that covered 50% of the vacuum wall. The pumping speed of the film and the amount of gas sorbed as functions of time have been measured. Rate-of-rise measurements were made before deposition and after saturation of the film with oxygen. The results indicate that the residual effects of the chromium film on the vacuum are due to reduced outgassing of the stainless steel surface.

38933 Hydrogen and deuterium in graphite limiters from TFTR, PDX and PLT. Wampler, W.R.; Doyle, B.L.; Pontau, A.E. (Sandia National Labs., Albuquerque, NM (USA); Sandia National Labs., Livermore, CA (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC04-76DP00789.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Retention of hydrogen isotopes in graphite limiters impacts plasma fueling, isotope changeover rates and tritium inventory in fusion reactors. This paper describes measurements of the amount of deuterium (D) in graphite tiles from the TFTR limiter, and in graphite limiters from PDX and PLT, after extended exposure to high power D plasmas. D concentrations decreased abruptly over the first micron and fell to the bulk value of 4 to 13 atomic ppm beyond 40 microns from the exposed surface. The average near-surface areal densities of D on the TFTR tiles was 10^{17} Dcm^2. The total amount of near-surface D in TFTR limiters estimated using this value is larger than the amount of D in a plasma but small compared to the allowed tritium inventory. The D concentrations found in the bulk are large enough to be an important factor for tritium inventory. The 1 at.% of hydrogen (H) found in the limiters and in graphite not exposed to plasma may be an important source of hydrogen to the plasma. We discuss the influence of the H and D concentrations found in the bulk of graphite on tritium inventory estimates and hydrogen isotope changeover rates.

38934 Local mixing model with sputtering/redeposition and projectile-implanted atom interaction. Brice, D.K.; Wampler, W.R. (Sandia National Labs., Albuquerque, NM (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC04-76DP00789.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

A previously discussed local mixing model (LMM) accurately describes the buildup of implanted hydrogen to saturation concentration and subsequent isotope exchange for implantation into a variety of materials of interest to the fusion community. Sputtering and surface deposition were not initially included in this model. We have now incorporated into the LMM the effects of sputtering and target-atom redepostion and have also included (in an approximate fashion) the slowing and scattering of implanted ions by previously implanted impurity species. This latter effect has important consequences for high fluence implants. Equations are derived which govern the evolution of the depth profiles of the implanted species and a formal solution is given for conditions which often are encountered in laboratory experiments. The time (fluence) dependence of the depth profile is discussed, and numerical results are compared with experiment for oxygen implantation into graphite at energies for which surface erosion is a significant effect. Solutions to the equations are also discussed for cases in which surface redeposition is significant. These latter solutions are pertinent to impurity and hydrogen isotope buildup in first wall components in operating fusion reactors.

38935 Sputtering/redeposition analysis of alkali-based tungsten composites for limiter/divertor applications. DeWald, A.B.; Brooks, J.N.; Krauss, A.R.; Gruen, D.M.; Valentine, M.G. (Corium Industries, Inc., Atlanta, GA (USA); Argonne National Lab., IL (USA); Georgia Inst. of Tech., Atlanta (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract W-31-109-ENG-38.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Composites of porous tungsten infiltrated with alkali metal-bearing alloys have been projected as a means of reducing plasma impurities and sputter erosion in magnetic fusion devices. Self-sustaining alkali metal overlayers have been observed to inhibit erosion of the underlying structural substrate by 2x to 10x. The alkali metal itself, insofar as it sputters as a secondary ion, is trapped at the surface by sheath potential and tangential magnetic fields. Self-regeneration of the alkali metal coating is obtained by thermal and radiation-induced segregation from the bulk. The sputtering and redeposition properties of several tungsten-based composites are analyzed for limiter and divertor plasma regimes in comparison to pure tungsten, Composites consisting of 20% to 80% porous tungsten infiltrated with binary alloys of Cu, Al, or Si and with alkali metal solutes have been identified for their high-temperature strength, high thermal conductivity, melt layer stability, and alkali metal replenishment characteristics. Is has been found that plasma edge temperatures in excess of 200 eV may be obtainable for a number of tungsten composites in contrast to pure tungsten for which the plasma edge temperature must be kept $\lesssim$ 50 eV to minimize plasma impurities and suppress runaway self-sputtering. In addition, the constraint of a low-Z surface in contact with the plasma may be unnecessary since for a given overlayer density, high-Z alkali metal overlayers are shown to reduce the substrate sputter erosion more efficiently than low-Z alkali metal overlayers.

38936 High plasma-flux elevated temperature sputtering of Cu-Li alloys. Krauss, A.R.; Gruen, D.M.; Mendelsohn, M.H.; Conn, R.W.; Goebel, D.M.; Hirooka, Y.; Leung, W.K. (Argonne National Lab., IL (USA); California Univ., Los Angeles (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—).

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Copper-lithium alloys ranging in composition from 3-12 at.% Li have been exposed to sputtering by 3×10^{16}-6×10^{17} 100 eV He^+ cm^2 s at temperatures of 300-500°C at the UCLA PISCES plasma service. Weight loss and optical spectroscopy techniques were used to determine the sputtering-induced erosion of the binary alloys relative to pure copper. It was found that the weight loss of the alloy and the amount of copper in the plasma as measured by emission spectroscopy in some cases was reduced by a factor of five or more. Post-irradiation analysis by Auger electron spectroscopy and scanning electron microscopy show a correlation between

lithium surface depletion, surface roughening, weight loss and partial erosion yields as measured by plasma emission spectroscopy. The results are explained in terms of formation of a lithium overlayer as a result of the elevated temperature and plasma ion bombardment. The formation of the overlayer is diffusion limited and depends on the sample conditioning, sample temperature, lithium concentration, method of preparation and plasma flux. The degree to which the copper erosion is reduced depends on the Li overlayer thickness, which is expected to depend on the sputtering yield of lithium on a copper substrate, the ion fraction of the sputtered lithium, the extent of subsurface lithium depletion and the duty cycle of the plasma device.

38937 Study of the vapor produced by intense energy deposition to materials. Croessmann, C.D.; Whitley, J.B.; Kulcinski, G.L. (Sandia National Labs., Albuquerque, NM (USA). Fusion Technology Div.; Wisconsin Univ., Madison (USA). Fusion Technology Inst.). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC04-76DP00789.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The power radiation and vapor formation due to intense energy deposition to materials was studied. Samples of molybdenum were subjected to series of 700 ms pulses from a 25 keV electron beam with energy fluxes of 8, 10, and 12 kWcm^{-2}. The power radiated by the subsequent vapor cloud was measured as a function of time and position with a broad band pyroelectric detector which revealed a constant radiation profile across the entire sample. To study the cloud formation, aluminum shrouds were positioned over samples of SS 304, Cu, graphite, and other materials of interest. Electron microprobe analysis of the films deposited on the shrouds after intense energy deposition to the samples showed that the vapor was anisotropically released from the sample to form a cloud directly between the condensed phases and the heat source.

38938 Collector probe measurements of deuterium and impurity fluxes in the ZT-40M reversed-field pinch. Bastasz, R.; Cayton, T.E. (Sandia National Labs., Livermore, CA (USA); Los Alamos National Lab., NM (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—).

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The edge plasma and impurity content of the ZT-40M reversed-field pinch during operation without limiters are characterized using silicon collector probes. After exposure to a number of deuterium discharges, analysis of the probe samples yields information about both the ion temperature and the impurity flux. Deuterium retention and depth profile measurements show that the charge-exchange outflux from ZT-40M consists of two components: A large 50 eV component and a smaller, energetic component corresponding to an ion temperature of ≈ 400 eV. Measured deposits of nickel, chromium, iron, and molybdenum atoms, which are the main constituents of the Inconel 625 liner, indicate that the flux of metal atoms is 1-2% of the total deuterium outflux.

38939 Impurity deposition on ALT-1 limiter heads. McGrath, R.T.; Doyle, B.L.; Pontau, A.E.; Thomas, G.J.; brooks, J.N. (Sandia National Labs., Albuquerque, NM (USA); Sandia National Labs., Livermore, CA (USA); Argonne National Lab., IL (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC04-76DP00789.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Detailed spatial profiles of impurities deposited on the surface of the ALT-I pumped limiter heads used in TEXTOR have been measured using proton induced X-ray emission in the external ion beam analysis system. The TiC coated, ATJ graphite ALT-I limiter head was analyzed after each of two plasma exposure periods. Measurements were also made on the uncoated ATJ limiter head. For limiter operation at plasma radii ranging from 40 to 46 cm we find large accumulations of metal impurities on the ion and electron sides of the limiter. The composition implies that the source of these impurities is predominantly the stainless steel main limiters in TEXTOR. Surface concentrations of iron as high as 10^{19}cm^{-2} have been measured. On each of the limiter front faces a relative maximum in metal concentration occurs near the tangency point and relative minima are found near the toroidal extremities. An analysis of impurity transport in the edge region of TEXTOR using Redep is also presented. The calculations predict impurity atom migration patterns that strongly resemble the measured metal atom deposition profiles. The analysis provides considerable insight into impurity transport in the tokamak edge. Benchmark calculations of this type are valuable for the design of future limiter or divertor systems.

38940 TFTR-conditioned graphite: Laboratory testing of properties affecting tokamak operations. Pontau, A.E.; Causey, R.A.; Bohdansky, J. (Sandia National Labs., Livermore, CA (USA); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—).

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The near-surface region of graphite limiters exposed to tokamak plasmas is significantly altered during discharges. In this study, we examine two 1984/85 TFTR movable limiter tiles exposed to approximately 2700 high power discharges. We find some properties of the TFTR-produced materials to be different from those of graphite. Deuterium sputtering weight loss can be characterized by carbon erosion in some areas and carbon plus metal erosion in others. Metallic impurities reduce the amount of methane produced during chemical sputtering. Adsorption and subsequent thermal desorption of light impurities by tile materials can be greater than that of non-TFTR-exposed graphite, with variations probably caused by surface area differences. Tritium uptake from a plasma is greater for the tile material. The magnitude and some of the implications of these effects on tokamak operation are discussed.

38941 Density drift in Textor with a graphite pumped limiter. Thomas, G.J.; Campbell, G.A.; Conn, R.W.; Goebel, D.W.; Dippel, K.H.; Finken, K.H. (Sandia National Labs., Livermore, CA (USA); California Univ., Los Angeles (USA); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—).

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

A significant material related effect on plasma density has been observed during ALT-I pumped limiter experiments in the Textor tokamak. In previous experiments, Textor was shown to have stable and reproducible discharges. However, during recent operation with a graphite pumped limiter head, the plasma density was observed to drift continuously down toward lower values in successive discharges even though all other plasma parameters (e.g., fueling) were held constant. This effect was found to be reproducible and independent of wall conditions, occuring with high power loading of the limiter head. It is believed that the decreasing plasma density is the result of changing recycling properties of the graphite limiter caused by the temperature excursion during each discharge.

38942 Two-dimensional impurity transport calculations for a high recycling divertor. Brooks, J.N. (Argonne National Lab., IL (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—).

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Two dimensional analysis of impurity transport in a high recycling divertor shows asymmetric particle fluxes to the divertor plate, low helium pumping efficiency, and high scrapeoff zone shielding for sputtered impurities.

38943 Consequences of resistive disruptions on vacuum vessel components. Merrill, B.J.; Jardin, S.C. (Idaho National Engineering Lab., Idaho Falls (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC07-76ID01570.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

A computer code, DSTAR, has recently been developed to quantitify the surface erosion and induced forces that can occur during major tokamak plasma disruptions. A disruption analysis has been performed with DSTAR for the Tokamak Fusion Core Experiment (TFCX) device. The limiters and inboard first wall were assumed to be clad with beryllium. Disruption simulations were performed with and without these structures present, to determine their electromagnetic influence. The conclusion is drawn that disruption simulations that do not include both the thermal and electromagnetic response of the vacuum vessel will not result in an accurate erosion prediction.

38944 Erosion and redeposition experiments in the PISCES facility. Goebel, D.M.; Hirooka, Y.; Conn, R.W.; Leung, W.K.; Campbell, G.A.; Bohdansky, J.; Wilson, K.L.; Bauer, W.; Causey, R.A.; Pontau, A.E. (California Univ., Los Angeles (USA). Center for Fusion Physics and Engineering; Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Sandia National Labs., Livermore, CA (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AS03-84ER52104;AC04-76DP00789.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The modification of surfaces during exposure to plasma bombardment is a critical issue in the development of limiter and wall materials for fusion confinement experiments. Controlled studies of the erosion and redeposition of materials during high flux and fluence plasma exposure are now possible in the PISCES facility. PISCES is a continuously operating plasma device which has achieved hydrogen plasma densities of over 10^{13} cm^{-3} and electron temperatures of 5 to 24 eV over large areas. Ion fluxes of 10^{17} to 10^{19} cm^{-2} s^{-1} and fluences of up to 10^{23} cm^{-2} have been used to bombard biased samples inserted into the plasma. The plasma parameters can be selected to produce simple sputtering, or redeposition by the ionization and recycling of the sputtered target materials. Collaborative studies on the performance of Cu and Cu-Li alloys (with ANL), stainless steel (with SNLL), and graphite (with IPP at Garching, and SNLL) have been undertaken. Surface topography modification is always observed after a sufficient fluence is achieved. The net erosion rate is significantly lower during redeposition than one would expect from classical sputtering yields. The transport and deposition of different materials by the plasma to the samples during redeposition conditions results in greatly modified surface composition and morphology. Chemical sputtering of graphite during low energy, high flux ($> 10^{18}$ cm^{-2} s^{-1}) plasma bombardment is observed. Chemically formed hydrocarbons are relatively easily redeposited compared to sputtered carbon. The performance of these materials, the surface morphology evolution, and the characteristics of the redeposited materials are discussed.

38945 Pump limiter studies on the Heliotron-E device. Hillis, D.L.; Mioduszewski, P.K.; Zuhr, R.A.; Clausing, R.E.; Baity, F.W.; Fowler, R.H.; Rome, J.A.; Motojima, O.; Mizuuchi, T.; Mutoh, T. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **145-147**: vp(Feb 1987). (CONF-860522—). Contract AC05-84OR21400.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Particle control with pump limiters has been successfully demonstrated in a variety to tokamaks. This experiment has obtained, for the first time, experimental data on pump limiter operation in a heliotron configuration. A movable pump limiter module was installed on a horizontal midplane port of Heliotron-E. The limiter module was installed on a horizontal midplane port of Heliotron-E. The limiter assembly consists of a TiC-coated graphite head with single-sided particle collection and active pumping. The location of the limiter is varied from near the vacuum vessel wall or up to 8 cm inside the last closed magnetic flux surface. This flexibility permits the study of a heliotron plasma that is limited either by the magnetic separatrix or by a material limiter. In the configuration investigated, only very low pressures are observed in the pump limiter when it is located outside the last closed flux surface, indicating that the scrape-off layer density is very low ($< 5x10^{11}$ cm^{-3}). For limiter positions inside the last closed flux surface, pressures of 2-6 mTorr are observed (similar to comparable tokamak operation). Erosion patterns on the vacuum vessel, as well as hot spots on the limiter head, indicate that the particle flow out of the confined plasma exhibits complicated patterns. This suggests that for efficient particle collection in a stellarator, pump limiters must be matched to the particle flow patterns.

38946 Testing electrical insulation of LCT coils and instrumentation. Luton, J.N.; Ulbricht, A.R.; Ellis, J.F.; Shen, S.S.; Wilson, C.T.; Okuno, K.; Siewerdt, L.O.; Wuechner, F.; Zahn, G.R.; Zichy, J.A. (Oak Ridge National Lab., P.O. Box Y, Bldg. 9204-1, MS-14, Oak Ridge, TN 37831 (US)). pp 1741-1748 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Three of the superconducting test coils in the Large Coil Task (LCT) use conductors cooled internally by forced flow of helium. In the other three coils, the conductors are cooled externally by a bath of helium. The coils and facility are designed for rapid discharges (dumps) at voltages up to 2.5 kV, depending on coil design. Many coil sensors are connected electrically to the conductors. These sensor leads and signal conditioning equipment also experience high voltage. High-potential tests of ground insulation were performed on all components of the International Fusion Superconducting Magnet Test Facility (IFSMTF0). Coil insulation was also tested by ring-down tests that produced voltage distributions within the coils like those occurring during rapid discharge. Methods were developed to localize problem areas and to eliminate them. The effect on breakdown voltage near the Paschen minimum of magnetic fields up to 2 T was investigated.

38947 Response of superconducting coils to internal heating. Okuno, K.; Mukai, H.; Lubell, M.S.; Shen, S.S.; Jakob, B.; Zichy, J.A.; Wuechner, F. (Oak Ridge National Lab., P.O. Box Y, Bldg. 9204-1, MS-14, Oak Ridge, TN 37831 (US)). pp 1733-1740 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Development testing of six different superconducting toroidal field coils from four countries in the Large Coil Task has included investigation of each coil's tolerance for various forms of heating, such as may be encountered in the magnets of a fusion reactor. Embedded heaters and temperature and voltage sensors in the coils were used in stability tests, simulated nuclear heating tests, and measurements of current-sharing temperature at high fields and currents. Results were gratifying and promise to be useful in design of magnets for reactors.

38948 Experimental tests of a large noncircular RFP. Sarff, J.S.; Almagri, A.F.; Assadi, S.; Dexter, R.N.; Prager, S.C.; Sprott, J.C. (Univ. of Wisconsin, Madison, WI (US)). pp 107-108 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Within a large noncircular conducting shell, originally that of the Wisconsin Levitated Octupole, the authors have examined reversed-field-pinch (RFP) plasmas in order to (1) investigate plasma control aspects of a large RFP (R=1.4 m, average minor radius=0.5 m), (2) establish that an RFP with noncircular boundary can be sustained by dynamo activity, (3) examine the effect of poloidal magnetic field curvature on RFP stability (the shell con-

tains a 35% indentation at the midplane), and (4) investigate the possibility of obtaining sustained RFP plasmas in a poloidal divertor configuration. The device is unconventional in that the 5 cm thick aluminum vacuum steel vessel with single poloidal and toroidal gaps serves as both the vacuum liner and conducting shell. The poloidal gap is protected with a 20 cm wide ceramic strip and self-reversed RFP plasmas are initiated with a toroidal loop voltage of —200 volts/turn. The best plasmas have peak currents of 300 kA and are sustained 10 msec (over ten resistive diffusion times). The conductivity temperature is —20 eV while the impurity carbon doppler width temperature is —60 eV. Unlike typical RFP experiments, no reduction in fluctuation level accompanies the toroidal field-reversal.

38949 Measurement of viscous drag on a high velocity plasma armature. Parker, J.V. (Los Alamos National Lab., Los Alamos, NM 87545 (US)). pp 108 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Viscous drag forces strongly influence the motion of railgun plasma armatures at high velocity. Computer modeling of railgun experiments indicates that viscous drag, acting either directly on the armature or directly on a restrike plasma, is the main obstacle to reaching velocities over 10 kms. Experimental measurements of viscous drag are difficult to perform due to the complex behavior of railgun plasma armatures and the high cost of performing high velocity railgun tests. To overcome these limitations a "free-arc" technique has been developed. The "free-arc" technique utilitizes a conventional railgun apparatus with the projectile replaced by a low pressure gas. The gas is required to obtain a well defined plasma region. With the proper choice of gas pressure and driving current, only a small fraction of the magnetic force is needed to expel the initial gas fill. A series of "free-arc" experiments have been performed using the MIDI-2 railgun at Los Alamos. MIDI-2 is a small, low-current device intended mainly for materials investigations. It has a 9.5 x 9.5 mm^2 square bore, a useful length of 1.65 m and a peak operating current of 150 kA. In the "free-arc" mode a plasma velocity of 10-12 kms can be achieved routinely at 100 kA current.

38950 Acceleration to hypervelocities using minimum energy concepts. Marklin, G. (Los Alamos National Lab. (US)). pp 110-111 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Recent experiments at Los Alamos National Laboratory (LANL) and elsewhere have demonstrated that the gross behavior of magnetized plasma containing helicity (linked magnetic fluxes) can be accurately predicted by the "Taylor Minimum Energy Principle" state which has the minimum magnetic energy possible for a given amount of helicity. This minimum energy configurations or "Taylor State" is described by the eigenvalue equation dell x B-vector = λB-vector where λ eigenvalue. The structure of the magnetic field is thus completely determined by the geometry of the container (i.e., the boundary conditions). A study of solutions to this equation for different geometries shows that there exist configurations where small changes in the geometry of a container can lead to large changes in the spatial distribution of magnetic energy with in the container. In particular, it is actually possible to have a situation where magnetic energy can be built up on a long time scale in one region and then switched into another region with a much smaller volume on a very short time scale, thus giving both energy and power compression. Experiments have begun at Los Alamos to demonstrate this process and to investigate its use in accelerating projectiles to hypervelocity. This poster describes calculations using the minimum energy principle to illustrate how this switching process works and to calculate how projectiles are accelerated in the Los Alamos experiment.

38951 Numerical modeling of the plasma ring acceleration experiment. Eddleman, J.L.; Hammer, J.H.; Hartman, C.W. (Lawrence Livermore National Lab. (US)). pp 106-107 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract W-7405-ENG-48.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Modeling of the LLNL RACE experiment and its many applications has necessitated the development and use of a wide array of computational tools. The two-dimensional MHD code, HAM, has been used to model the formation of a compact torus plasma ring in a magnetized coaxial gun and its subsequent acceleration by an additional applied toroidal field. Features included in the 2-D calculations are self-consistent models for (1) the time-dependent poloidal field produced by a capacitor bank discharge through a solenoid field coil (located either inside the gun inner electrode or outside the outer gun electrode) and the associated diffusion of magnetic flux through neighboring conductors, (2) gas flow into the gun annular region from a simulated puffed gas valve plenum, (3) formation and motion of a current sheet produced by J x B forces resulting from discharge of the gun capacitor bank through the plasma load between the coaxial gun electrodes, (4) the subsequent stretching and reconnection of the poloidal field lines to form a compact torus plasma ring, and (5) finally the discharge of the accelerator capacitor bank producing an additional toroidal field for acceleration of the plasma ring. The code has been extended to include various models for gas breakdown, plasma anomalous resistivity, and mass entrainment from ablation of electrode material.

38952 High density Z pinch formed from a solid deuterium fiber. Hammel, J.E.; Scudder, D.W. (Los Alamos National Lab. (US)). pp 107 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A Z pinch formed from a fiber of solid deuterium has been operating in Los Alamos since August 1985. The ultimate goal of these experiments is the achievement of a deuterium plasma temperature of 10 keV in an ohmically heated equilibrium pinch stable for several Lawson times. Out approach is to form the pinch from a small diameter solid deuterium fiber and provide a current rise rate which will maintain radial pressure equilibrium, thereby avoiding the violent implosion of classical Z pinches and gas-puff pinches. Solid deuterium fibers with diameters between 20 μm and 40 μm are produced with a cryogenic extruder developed at Los Alamos. A 40 μm fiber would produce an equilibrium temperature > 10 keV at the Pease- Braginski current of 1.4 MA. The experiment now operating provides a plasma current of 250 kA with a 120 ns risetime from a 600 kV Marx banktransmission line current generator with an impedance of 1.5Ω. A well-behaved channel is routinely achieved with plasma temperatures > 300 eV at a density of 2 x 10^{21} cm^{-3} at 250 kA. The plasma characteristics are determined from multifrance schlieren photography, soft x-ray diodes, x-ray pinhole photographs and both time-integrated and time-resolved neutron detectors. The multiframe schlieren photographs taken at 10 ns intervals show a straight uniform channel in Bennett equilibrium for at least 60 ns. m = 0 features are seen at late times while m= 1 is not observed. Stable time is > 60 sound transit times. The neutron number is in reasonable agreement with the x-ray data.

99 GENERAL AND MISCELLANEOUS

REFER ALSO TO CITATION(S) 36499, 36502, 38123

38953 (CONF-8805103—2) Public alert and warning systems for chemical plant emergencies. Sorensen, J.; Rogers, G.; Fisher, D. (Oak Ridge National Lab., TN (USA); Federal Emergency Management Agency, Washington, DC (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011007/JAW.

From Hazardous material spills conference; Chicago, IL, USA (16 May 1988).

This paper assesses public warning systems for fixed-site chemical facilities. Based on data collected in 137 communities, current warning systems, except in a few cases, lag behind what can be defined as state-of-the-art practices. The current systems will likely be adequate for slowly developing events, but would fail to provide timely warning in a rapid release situation.

38954 **(EUR—10815-DE) Selected EC patents.** (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation). 1986. 378p. (In German). Commission of the European Communities, Luxembourg. Office for Official Publications of the European Communities.

The activities of the EC Commission on the patent sector are illustrated by a selection of EC research findings for which patents were granted. With 67 figs., 7 tabs.

38955 **(ORAU—88/A-73) Technical training: Challenge in a changing environment.** (Oak Ridge Associated Universities, Inc., TN (USA)). Feb 1988. Contract AC05-76OR00033. 121p. (CONF-8710184—). NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88009043/JAW.

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

Purpose is to facilitate contractor-to-contractor exchange of training program information and resources as a means to improve the quality of training at all US DOE facilities. Thirteen papers are included, with emphasis on radiation protection, hazardous materials, and good instruction. (DLC)

38956 **(SAND—87-2276) A method for reducing the coning of a spinning vehicle.** Criel, T.M.; Cole, J.K.; Wyatt, F.V. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010971/JAW.

A technique for deconing a vehicle is described that involves only a single accelerometer or rate gyro, a thruster, and an electronic control unit. The testing of this technique is reviewed, and variations of the technique that can reduce the propellant required to decone are considered. A brief discussion of the dynamics of vehicles that are coning in space is also included to introduce the concept of deconing.

38957 **(SAND—88-0573C) Exterior field evaluation of new generation video motion detection systems.** Malone, T.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880631—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011919/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Recent advancements in video motion detection (VMD) system design and technology have resulted in several new commercial VMD systems. Considerable interest in the new VMD systems has been generated because the systems are advertised to work effectively in exterior applications. Previous VMD systems, when used in an exterior environment, tended to have very high nuisance alarm rates due to weather conditions, wildlife activity and lighting variations. The new VMD systems advertise more advanced processing of the incoming video signal which is aimed at rejecting exterior environment nuisance alarm sources while maintaining a high detection capability. This paper discusses the results of field testing, in an exterior environment, of two new VMD systems. The field tests were conducted in a video/sensor test bed area with double fenced perimeter security type zones. Testing included detection capability evaluation of human targets crossing the perimeter zones and nuisance alarm data gathering. The testing was conducting in order to characterize each of the VMD system's performance in a particular exterior environment. Test results reveal some of the strengths and weaknesses of each system for the conditions tested, and some site considerations if a VMD system is being considered for exterior use.

9901 Management

REFER ALSO TO CITATION(S) 38890

38958 **(CONF-880379—1) Productivity improvement - Resource management.** Jones, R.W. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations). 1988. Contract AC08-88NV10617. 33p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008057/JAW.

From DOE maintenance management conference; New Orleans, LA, USA (28 Mar 1988).

Productivity improvement and resource management as it relates to productivity is discussed. Viewgraphs accompany the discussion.

38959 **(CONF-880631—5) How much quality assurance?.** Beatty, R.A.; Talboy, J.H. (Argonne National Lab., IL (USA)). 13 Apr 1988. Contract W-31109-ENG-38. 9p. (CONF-880631—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009583/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

This paper describes the approach used at Argonne National Laboratory to apply the techniques of quality assurance to research and development activities. The discussion includes the approach, the reasons that it is gaining acceptance, and its wide applicability. This approach is founded on the lessons learned in management of quality at Argonne National Laboratory over a period of more than 15 years. The discussion is confined to the practices at the Illinois site of the Laboratory where more than 3000 researchers and support personnel conduct basic and technology-directed research.

38960 **(CONF-880698—2) A knowledge-based manager for software projects.** Agarwal, A.; Jairam, B.N.; Emrich, M.L.; Murthy, N. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010436/JAW.

From 1. international conference on industrial and engineering applications of artificial intelligence and expert systems; Tullahoma, TN, USA (2 Jun 1988).

Management aspects of software development have received little research interest. The SOFTMAN system addresses the automation of this feature of the SDLC. It is a knowledge-based system which tracks the health of a software development effort. By comparing user metrics to past environment standards, anomalies in the coding stage are detected and suggestions for solving them are offered. In addition, SOFTMAN can be used to tutor new personnel, perform what-if anaylsis, and build a corporate memory regarding managment decisions. 15 refs., 2 figs.

38961 **(CONF-8804115—1) Knowledge-based cost estimating vs traditional software cost models.** Arrowood, L.F.; Emrich, M.L.; Sadlowe, A.R.; Jones, K.A.; Watson, B.D.; Surapaneni, R. (Oak Ridge National Lab., TN (USA)). 12 Apr 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009707/JAW.

From 2. annual Engineering Society of Detroit SMI expert systems 88 solutions in manufacturing conference and exhibition; Detroit, MI, USA (12 Apr 1988).

A knowledge-based system, ADP-Estimator, is under development to perform ADP project cost estimating. Designed to retain crucial expertise held by experienced project leaders, this system allows new project leaders to interactively generate cost estimates. Initially, project leaders indicate constraints (e.g. personnel levels, equipment, and facilities) placed upon a project. The system uses these to identify resources and procedures required for project completion. The efficacy of this system is compared with manual efforts and traditional software cost models.

38962 **(DOE/IG—0008/10-5) Office of Inspector General semiannual report to the Congress, October 1, 1987 to March 31, 1988.** Layton, J.C. (USDOE, Washington, DC). May 1988. 79p. H. Order Number TI88011769/JAW.

We issued 219 audit and inspection reports during this period. As a result of reviews of cost proposals and contract billings, we determined that $95.8 million in costs were either unallowable or unsupported. On reports where a final Departmental position was received, management committed to more efficient use of funds totaling $200.8 million. Our investigations of wrongdoing led to 21 referrals for prosecution, 6 convictions, 7 indictments, and 17 disciplinary actions. The investigations also resulted in the recovery for the Department of $375,180.

38963 **(DOE/MA—0338) Technical skills training program course directory.** (USDOE Assistant Secretary for Management and Administration, Washington, DC). Jun 1988. 62p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011678/JAW.

The departmentally adminstered Technical Skills Training Program encompasses three functional areas: Program Management Skills, Project Management Skills and Procurement and Assistance Skills Training. Primary emphasis is directed at providing DOE employees the specific work-related skills necessary to perform effectively and efficiently. This directory contains descriptions of the courses available in the three program areas and general information for participation in the training programs. Separate sections have been reserved for the Current Year Schedule and listings of the Headquarters and Field Trainig Office Coordinators.

38964 **(DOE/MA—0342) Analysis of benefits and costs (ABC's) guideline: Volume 1, A manager's guide to analysis of benefits and costs.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of ADP Management). Jun 1988. 20p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88011700/JAW.

Managers spend much of their time and effort planning for the future. These plans usually involve making decisions about how to spend scarce resources. This guideline explains a process which will aid managers in making these choices. This process, a stuctured approach to decision making, is an Analysis of Benefits and Costs (ABC). ABC's are also known as Benefit-Cost, Economic or Investment Analysis. In particular, this guideline explains the usefulness of ABC's in making choices among competing alternatives concerning Information Resource Management (IRM).

38965 **(DOE/MA—0343) Analysis of benefits and costs (ABC's) guideline: Volume 2, An analyst's handbook for analysis of benefits and costs.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of ADP Management). Jun 1988. 76p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88011354/JAW.

This handbook is for information technology personnel with little or no previous experience in the analysis of benefits and costs (ABC). This handbook describes the essential concepts and procedures necessary to conduct an ABC. It also explains the use of ABC's to support decisions related to information resources management (IRM). A companion volume,"A Manager's Guide to Analysis of Benefits and Costs," explains the importance of ABC's to the Department of Energy's IRM decision making.

38966 **(DOE/OR/17883—T1) Report of activities performed for the period 1 July 1986-30 June 1987.** (National Research Council, Washington, DC (USA). Numerical Data Advisory Board). 1988. Contract FG05-82TC11276;AP05-87OR17883. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006904/JAW.

This document discusses the activities of the Numerical Data Advisory Board from July 1, 1986 through June 30, 1987. (FP)

38967 **(EGG-M—00388) Mutually exclusive alternatives by clustering.** Mooney, E.; Ross, T. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 5p. (CONF-880591—1). NTIS, PC A02;3. Order Number DE88007707/JAW.

From Institute of Industrial Engineers meeting; Orlando, FL, USA (22 May 1988).

This paper begins with a brief introduction to cluster analysis and an overview of its application in the identification of mutually exclusive alternatives for economic analysis. The approach is then illustrated with an example, followed by some concluding remarks. The example involves maintenance of minicomputers at INEL.

38968 **(INIS-GB—139) Corporate Plan (for the National Radiological Protection Board) 1988/89 to 1992/93.** (National Radiological Protection Board, Chilton (UK)). Apr 1988. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753990/JAW.

The Cabinet Office (Management and Personnel Office), when setting down guidelines, recommended that all Non-Departmental Public Bodies such as the Board should prepare Corporate Plans against which the performance of the organisation and the relevance of the activities to contemporary requirements could be better measured. To that end, the Board now prepares a Corporate Plan annually. This year's plan is for the financial period 1988/89 through to 1992/93, both years inclusive. The document indicates the broad programme areas in which the Board intends to concentrate its efforts, and the trends it expects over the planning period. The Board's overall strategy is to cover a wide range of relevant radiological protection matters, but with most emphasis on those likely to become major points of public or governmental concern in the near future. Major issues are expected to be: new estimates of the risks associated with radiation exposure and subsequent international and national recommendations on dose limitation; public exposures and aspects of radiation in the environment; and increasing awareness of non-ionising radiation. The Board is partly dependent upon receipts from its commercial activities and must, therefore, also look at the provision of services and prepare to meet the demands likely to arise in the 1990s.

38969 **(K/C—1482) Work for others program plan, FY 1988-FY 1992.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Apr 1988. Contract AC05-84OT21400. 44p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011533/JAW.

This document is the third annual program plan that summarizes the work for others (WFO) performed by Martin Marietta Energy Systems, Inc., in Department of Energy (DOE)-Oak Ridge Operations (ORO) facilities. The period covered by this plan is FY 1988 through FY 1992. In this document, WFO is defined as work performed for non-DOE programs; it excludes work on in-house DOE programs and work for other DOE labs and contractors. Descriptions of WFO activities in eight major program areas, estimates of expected operating costs and personnel levels, and a description of the management structure and actions to integrate and control WFO activities are presented. Some examples of major recent successes in the WFO programs are also included in an appendix. The major emphasis is on work for other federal agencies (WFOFA) since those activites constitute more than 95% of the total WFO program; the remaining WFO activities are performed for state and local governments, foreign institutions, and the private sector. 6 figs., 7 tabs.

38970 **(LA-UR—88-194) New developments in capital cost estimating.** Stutz, R.A.; Zocher, M.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880728—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88005392/JAW.

From 32. annual meeting of the American Association of Cost Engineers and the 10th international cost engineering congress; New York, NY, USA (10 Jul 1988).

The new developments in cost engineering revolve around the ability to capture information that in the past could not be automated. The purpose of automation is not to eliminate the expert cost engineer. The goal is to use available technology to have more information available to the professionals in the cost engineering field. In that sense, the demand for expertise increases in order to produce the highest quality estimate and project possible from all levels of cost engineers. We cannot overemphasize the importance of using a good source of expert information in building these types of programs. "Garbage in, garbage out" still applies in this form of programming. Expert systems technology will become commonplace in many vertical markets; it is important to undersand what can and cannot be accomplished in our field, and where this technology will lead us in the future.

38971 **(OEFZS-A—1058) HTR research and development in Austria.** Proksch, E.; Fritz, K.; Neumann, W. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Sep 1987. 6p. (CH—376/87; WE—442/87; RS—295/87). Austrian Research Centre Seibersdorf, A-2444 Seibersdorf (Austria).

Limited Distribution.

This report summarizes R and D work on: high-temperature reactor fuels, high-temperature structural materials, and high-temperature helium test rig/prestressed concrete pressure vessel, which was performed in Austria since the 6th Meeting of the International Working Group on Gas-Cooled Reactors of the IAEA. 8 refs.

38972 **(ORAU—88/B-2) Prescriptions for growth: A status report on U.S. Department of Energy communications with colleges land universities.** Morrison, W.D.; Rodman, J.A. (Oak Ridge Associated Universities, Inc., TN (USA)). Feb 1988. Contract AC05-76OR00033. 59p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009036/JAW.

This report presents the results of a study designed to evaluate the effectiveness of DOE communications with the nation's colleges and universities. A 1983 report of the Energy Research Advisory Board (ERAB) entitled An Assessment of the Relationship Between the Department of Energy and Universities and Colleges (the ERAB report) concluded that relationships between US Department of Energy and the academic community would be significantly enhanced by the development of effective reciprocal communication process. The ERAB report identified many communication-related issues that impact the important working relationship between DOE and acedeme. 9 figs.

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REFER ALSO TO CITATION(S) 37029, 37370, 38514

38973 **(AD-A—190201/4/XAB) Approximation methods for the identification and control of distributed-parameter systems. Final technical report, 1 October 1984-30 September 1987.** Rosen, I.G. (University of Southern California, Los Angeles (USA). Dept. of Mathematics). 20 Nov 1987. 43p. NTIS, PC A03/MF A01.

Efforts to develop computational methods for the identification and optimal control of linear and nonlinear systems governed by distributed-parameter systems are reported on. Specifically, approximation methods for determining Optimal LOG compensators (feedback control and estimator gains) and functional parameters in linear and nonlinear partial differential equations and hereditary systems were developed, analyzed, and tested. The study included theoretical, experimental, and numerical components. Covergence theories for spline-based and modal finite-element schemes were established, and extensive numerical studies on both conventional (serial) and vector supercomputers were carried out. A parameter estimation scheme was tested using experimental data taken from the RPL structure, a laboratory experiment designed to test control algorithms for the large-angle slewing of spacecraft with flexible appendages, and other projects involving the identification of flexible structures based upon experimental data were initiated.

38974 **(AD-A—190236/0/XAB) Transformations of concurrent algorithms for highly parallel systems: a one-year project summary report. Final report for period ending 1 October 1987.** Gannon, D. (Indiana Univ., Bloomington (USA). Dept. of Computer Science). Oct 1987. 6p. NTIS, PC A02/MF A01.

It has become a certainty that Multiple Instruction Stream, Multiple Data Stream (MIMD) parallel architectures are going to play a major role in all aspects of high-speed computer design for the foreseeable future. What is not clear is whether we will be able to devise a means to design algorithms and software for these machines that transcends our current ad-hoc, nonportable techniques. In this project the author focused on the portability issue from the perspective of parallel-algorithm design and how it effects the internal organization of advanced compilers. The eventual goal of the project is to produce an expert system that can help users transform large, complex applications from one highly parallel machine to another. The basic strategy has been to follow the following plan: 1) Build an experimental research laboratory for parallel computation; 2) Design an experimental program of research that would shed light on the problems involved with restructuring parallel programs for different machines; 3) Attempt to provide a mathematical characterization of the properties of the machines and how algorithms must be restructured to run on them; and 4) Attempt to design a model of machine architecture that can be embedded into the inference engine or knowledge base of an expert system for program restructuring.

38975 **(AD-A—190383/0/XAB) MultiScheme: a parallel-processing system based on MIT (Massachusetts Institute of Technology) scheme. Doctoral thesis.** Miller, J.S. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Sep 1987. 247p. (MIT/LCS/TR—402). NTIS, PC A11/MF A01.

MultiScheme is a fully operational parallel-programming system based upon the Scheme dialect of Lisp. Like its Lisp ancestors, MultiScheme provides a conducive environment for prototyping and testing new linguistic structures and programming methodologies. MultiScheme supports a diverse community of users who have a wide range of interests in parallel programming. MultiScheme's flexible support for system-based experiments in parallel processing has enabled it to serve as a development vehicle for university and industrial research. At the same time, MultiScheme is sufficiently robust, and supports a sufficiently wide range of parallel-processing applications, that it has become the base for a commercial product, the Butterfly Lisp System produced by BBN Advanced Computers, Inc.

38976 **(AD-A—190389/7/XAB) Synapses that compute motion. Memorandum report.** Poggio, T.; Koch, C. (Massachusetts Inst. of Tech., Cambridge (USA). Artificial Intelligence Lab.). Jun 1987. 14p. (AI-M—973). NTIS, PC A03/MF A01.

Biophysics of computation is a new field that attempts to characterize the role in information processing of the several biophysical mechanisms in neurons, synapses, and membranes that have been uncovered in recent years. This article reviews a synaptic mechanism, based on the interaction between excitation and silent inhibition, that implements a veto-like operation. Synapses of this type may underlie direction selectivity to direction of motion in the vertebrate retina.

38977 **(AD-A—190557/9/XAB) Inquiry into the benefits of multigauge parallel computation. Technical report.** Snyder, L. (Washington Univ., Seattle (USA). Dept. of Computer Science). May 1985. 7p. (TR—85-06-03). NTIS, PC A02/MF A01.

A multigauge parallel computer is a machine whose processor elements can be partitioned into distinct processors with narrower data paths; ILLIAC IV was a multigauge machine. This paper addresses the question of whether multigauge computation is useful. First, the concept is defined. Next, it is argued that multigauge machines offer truly new computational facilities, rather than being other architectures in disguise. Finally , a class of algorithms is identified that can exploit multigauge architectures and an example is presented to illustrate multigauge machine performance improvements.

38978 **(AD-A—190558/7/XAB) Playing Poker: a full programming example using the Poker environment. Technical report.** Snyder, L. (Washington Univ., Seattle (USA). Dept. of Computer Science). Sep 1985. 40p. (TR—85-09-02). NTIS, PC A03/MF A01.

This document is intended to serve as a sample program for the Poker Parallel Programming Environment. However, Poker programs do not exist in the traditional sense: there is no monolithic sequence of symbolic text. Rather, Poker keeps a source data base that the programmer can view and change using interactive graphics. Data bases and interactive graphics may be very convenient for the programmer, but they are not easily conveyed in hardcopy form. So, in an effort to provide some sense of the course of a Poker programming session, this example is intended to be as com-

prehensible as possible without requiring the reader to be fully familiar with the massive background material. The presentation is directed at two audiences: those who do not have Poker available but would like to see specific details in a form not as dry as a reference manual, and those who do have Poker available and would like a quick way to gain operational proficiency. Both audiences can learn how things are done in Poker. For an explanation of why things are done as they are, two papers, written for general audiences, are available, one on Poker and one on the CHIP architecture.

38979 (AD-A—190571/0/XAB) Modeling, simulation, and comparison of interconnection networks for parallel processing. Master's thesis. Raines, R.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 117p. (AFIT/GCE/ENG—87D-8). NTIS, PC A06/MF A01.

This thesis extends existing modeling, analysis, and comparison of interconnection networks for parallel-processing systems. Simulation models are developed for the multistage cube network, the single-stage cube network (hypercube), and the Illiac IV mesh-type network. They are then used to provide a comparison of three classes of interconnection networks which, until now, has not been performed. These models are implemented using a commercially packaged simulation language provide for compact source code and ease of readability. The networks are modeled under a common set of operating assumptions and system environment. This allows for accurate comparisons of average network packet delays an memory requirements necessary to physically implement the chosen network at a given network operating load. It is concluded that, for the network sizes and operating conditions established, the multistage cube network performs better at a lower hardware cost than do the single-stage cube and mesh networks. As a result, the designer of a parallel-processing system is given additional insight for choosing an interconnection network which best suits the application needs.

38980 (AD-A—190578/5/XAB) Masking fields: a massively parallel neural architecture for learning, recognizing, and predicting multiple groupings of patterned data. Cohen, M.A.; Grossberg, S. (Boston Univ., MA (USA). Center for Adaptive Systems). 15 May 1987. 25p. NTIS, PC A03/MF A01.

Pub. in Applied Optics, Vol. 26, No. 10, 1866-1891(15 May 1987).

A massively parallel neural-network architecture, called a masking field, is characterized through systematic computer simulations. A masking field can simultaneously detect multiple groupings within its input patterns and assign activation weights to the codes for these groupings that are predictive with respect to the contextual information embedded within the patterns and the prior learning of the system. A masking field automatically rescales its sensitivity as the overall size of an input pattern changes, yet also remains sensitive to the microstructure within each pattern. Thus, a masking field suggests a solution of the credit assignment problem by embodying a real-time code for the predictive evidence contained within its input patterns. Such capabilities are useful in speech recognition, visual object recognition, and cognitive information processing. An absolutely stable design for a masking field is disclosed through an analysis of the computer simulations. This design suggests how associative mechanisms, cooperative-competitive interactions, and modulatory gating signals can be joined together to regulate the learning of compressed recognition codes. Data about the neural substrates of learning and memory are compared to these mechanisms.

38981 (AD-A—190631/2/XAB) Poker 3.1: a programmer's reference guide. Technical report. Snyder, L. (Washington Univ., Seattle (USA). Dept. of Computer Science). Sep 1985. 63p. (TR—85-09-03). NTIS, PC A04/MF A01.

This document gives a succinct description of the facilities available with the Poker Programming Environment. The emphasis is on what is available rather than how to achieve particular results. Poker uses interactive graphics. The usual programming language notion of a source program as a monolithic piece of symbolic text has been replaced in Poker by a data base. Object programs (the compiled data base) are emulated by Poker and snapshots of the execution can be continuously displayed. Poker supports a variety of CHiP architectures; the current one can be displayed or changed using the CHiP Parameters facility. The back page of this document gives a summary of the commands. Other versions of Poker exist; consult Appendix B for your particular system.

38982 (AD-A—190633/8/XAB) Supercomputer environment. Annual technical report, 1 October 1986-30 September 1987. (Illinois Univ., Urbana (USA)). 30 Oct 1987. 7p. NTIS, PC A02/MF A01.

This summary covers goals and first-year accomplishments of the Faust project, a research effort to develop a software-engineering environment of supercomputer application development. The goal of Faust is to provide a user-friendly work station of integrated development tools that caters to a broad range of user expertise. Faust comprises individual efforts in the area of user-interface tools, expert systems, parallel program debugging, performance evaluation, symbolic processing, error analysis, and graphics. The Faust project is additionally supporting efforts in the areas of fluid and structural dynamics. Overall project goals are outlined, followed by a summary of first contract year's accomplishments that were presented to the Faust project review team on August 6, 1987.

38983 (AD-A—190683/3/XAB) Parallel artificial-intelligence search techniques for real-time applications. Master's thesis. Shakley, D.J. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 122p. (AFIT/GCS/ENG—87D-24). NTIS, PC A06/MF A01.

State-space search is an important component of many problem-solving methodologies. The computational models within Artificial Intelligence depend heavily upon state-space searches. Production systems are one such computational model. Production systems are being explored for real-time environments where timing is of a critical nature. Parallel processing of these systems and, in particular, concurrent state-space searching seems to provide a promising method to increase the performance (effective and efficient) of production systems in the real-time environment. Production systems in the form of expert systems, for example, are being used to govern the intelligent control of the Robotic Air Vehicle (RAV) which is currently a research project at the Air Force Wright Aeronautical Laboratories. Due to the nature of the RAV system, the associated expert system needs to perform in a demanding real-time environment. The use of a parallel-processing capability to support the associated computational requirement may be critical in this application. Thus, parallel search algorithms for real-time expert systems are designed, analyzed, and synthesized on the Texas Instruments (TI) Explorer and Intel Hypercube.

38984 (ANL—87-26-Vol.1) Proceedings of the focused research program on spectral theory and boundary value problems: Volume 1, Singular differential systems. Pieper, G.W. (ed.). (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 177p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88008151/JAW.

This is the first volume of a series of reports containing the proceedings of the Focused Research program on spectral theory and boundary value problems. The topics covered are: M(λ) theory for singular hamiltonian systems; M(λ)-computation for singular differential systems; Levinson's theorem and Titchmarch-Weyl M(λ) theory for Dirac systems; deficiency indices of powers of Sturm-Liouville expressions with large leading coefficient; and the Bessel-squared equation in the lim-2, lim-3, and lim-4 cases.

38985 (ANL—88-18) Research in mathematics and computer science at Argonne, July 1, 1986-January 6, 1988. Pieper, G.W. (ed.). (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 71p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88010343/JAW.

This report reviews the research activities in the Mathematics and Computer Science Division at Argonne National Laboratory for the period July 1, 1986, through January 6, 1988. The body of the report gives a brief look at the MCS staff and the research facilities, and discusses various projects carried out in two major

areas of research: analytical and numerical methods and advanced computer systems concepts. Information on division staff, visitors, workshops, and seminars is found in the appendixes. 6 figs.

38986 **(ANL/MCS-TM—110) Computing small singular values of bidiagonal matrices with guaranteed high relative accuracy: LAPACK working note # 3.** Demmel, J.; Kahan, W. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 44p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008465/JAW.

Computing the singular values of a bidiagonal matrix is the final phase of the standard algorithm for the singular value decomposition of a general matrix. We present a new algorithm which computes all the singular values of a bidiagonal matrix to high relative accuracy independent of their magnitudes. In contrast, the standard algorithm for bidiagonal matrices may compute small singular values with no relative accuracy at all. Numerical experiments show that the new algorithm is comparable in speed to the standard algorithm, and frequently faster. We also show how to accurately compute tiny eigenvalues of some classes of symmetric tridiagonal matrices using the same technique. 11 refs., 4 tabs.

38987 **(ANL/TM—400-Rev.1) MVS [Multiple Virtual Storage] batch computing and data management at ANL.** Thommes, M.M.; Hinds, A.R.; Thom, D.J. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 198p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88007342/JAW.

This manual describes the batch computing system running under MVS (Multiple Virtual Storage) on the IBM computers (two IBM 3033's) at Argonne National Laboratory. It serves as a guide to the Argonne MVS batch computing environment and recommends practices and modes of operation. It explains the terminology and conventions used at Argonne, describes some Job Control Language (JCL) needed to run your MVS batch jobs, and shows how to manage data files on disk and tape devices.

38988 **(ANL/TM—423-Rev.1) CMS [Conversational Monitor System] at ANL.** Gallo, M.A.; Caruthers, C.M. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31109-ENG-38. 50p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88010979/JAW.

CMS is IBM's Conversational Monitor System. It is an interactive system that runs on the red IBM 3033 computer with the operating control program (CP). Both CMS and CP are subsets of VM/SP (the Virtual Machine/System Product) operating system. Among other capabilities, CMS allows you to: create graphs and charts, send and receive electronic mail, create and run programs, format documents and memoranda (with embedded graphics), and query the Argonne telephone directory. In general, the VM/SP system and the OBS Wylbur system in MVS do not share the same disk space; however, procedures are available for transferring files between the two systems. You can also submit batch jobs created in CMS to the MVS batch system and monitor their execution. 5 tabs.

38989 **(ANL/TM—461) ANL site response for the DOE FY 1990 information technology resources long-range plan.** Boxberger, L.M.; Caruthers, C.M. (ed.). (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 233p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88009188/JAW.

As one of a continuing series, this Site Response is an update and extension of the Laboratory's previous submissions. The response contains both narrative and tabular material. It covers an eight-year period consisting of the base year (FY1987), the current year (FY1988), the budget year (FY1989), the plan year (FY1990), and the out years (FY1991-1994). This Site Response was compiled by Argonne National Laboratory's Computing Services organization, which has the responsibility to provide leadership in optimizing computing and information services and disseminating computer-related technologies throughout the Laboratory. The Site Response consists of four parts. Part 1: "Site Overview" describes the ANL Mission, overall organization structure, the strategic approach toward meeting information technology resource needs, the planning process, major issues, and points of contact. Part 2A: "Information Systems Plans for DOE Contractors" defines the current and planned automated information systems associated with the management of ANL, the stewardship of its resources, and the provision of day-to-day general operations and services. (Part 2B: "Information Systems Plans for DOE Organizations" and Part 2C: "FMS Plans for DOE Organizations" do not apply to Argonne National Laboratory.) Part 3: "Computing Resources Plan" defines the requirements, resources, acquisitions, and budget for computing at ANL for FY1987 through FY1994. Part 4: "Telecommunications Plan" documents the existing and planned telecommunications resources required at ANL from FY1987 through FY1994.

38990 **(BNL—39830-Rev.1) A guide to telecommunications at Brookhaven National Laboratory.** (Brookhaven National Lab., Upton, NY (USA)). Jun 1988. Contract AC02-76CH00016. 42p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011210/JAW.

38991 **(CEA-CONF—9239) Describing control.** Fouet, J.M.; Starynkevitch, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1987. 4p. (CONF-8708257—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753461/JAW.

From 10. international joint conference on artificial intelligence; Milan, Italy (23 Aug 1987).

Incremental development and maintenance of large systems imply that control be clearly separated from knowledge. Finding efficient control for a given class of knowledge is itself a matter of expertise, to which knowledge-based methods may and should be applied. We present here two attempts at building root systems that may later be tuned by knowledge engineers, using the semantics of each particular application. These systems are given heuristics in a declarative manner, which they use to control the application of heuristics. Eventually, some heuristics may be used to compile others (or themselves) into efficient pieces of programmed code.

38992 **(CEA-R—5420) Software for the automatic processing of alpha spectra, the Sesame code.** Pineira, T. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Protection contre les Rayonnements). Feb 1988. 46p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753479/JAW.

The SESAME code described in this document enables unfolding of alpha spectra by means of a simple method which can easily be implemented on a micro or minicomputer. The software is designed to unfold peaks of which the maxima are separate, but also includes provision for semi-automatic processing of peaks which are hidden or of which the energy levels are too close to be resolved by the automatic peak identification process. The method of unfolding used in the code has been chosen for the reason that it does not require any other information but the spectrum. The form of the peak is induced from the envelope of the spectrum without recourse to hypotheses concerning the shape of the peaks or to mathematical adjustments. The software has been validated and qualified, and is currently in regular use on a wide range of hardware.

38993 **(CONF-870565—Summs.) Summary of papers to be presented at the tenth computer security group conference.** (USDOE, Washington, DC). 1987. 123p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88012684/JAW.

From Department of Energy computer security group conference; Albuquerque, NM, USA (5 May 1987).

Issues surrounding the topics of computer hardware, software, and data transmission are addressed in the papers presented at this conference. Individual reports are indexed and abstracted separately. (DWL)

38994 **(CONF-871128—2) A comparative study of project estimating tools.** Jones, K.A.; Sadlowe, A.R.; Emrich, M.L.; Arrowood, L.F.; Watson, B.D.; Surapaneni, R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009059/JAW.

From NARDAC Washington/ORNL/DSRD conference on expert systems technology in the ADP environment; Washington, DC, USA (2 Nov 1987).

Existing project estimation software may adequately estimate programming costs associated with large software development projects. However, customizing these packages to reflect unique organizational requirements may be difficult. In addition, such systems may not offer justifications for indicated costs and personnel levels. A knowledge-based system, ADP-Estimator, is being developed to estimate project resources and costs. Such knowledge-based software can retain estimating expertise and make it available to other personnel.

38995 **(CONF-880585—1) Asynchronous production systems for real-time expert systems.** Sabharwal, A.S.; Iyengar, S.S.; Weisbin, C.R.; Pin, F.G. (Louisiana State Univ., Baton Rouge (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 34p. (CESAR—88/08). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008374/JAW.

From Avignon '88: 8th international workshop on expert systems and their applications; Nanterre, France (30 May 1988).

Intelligent Computing Systems for Autonomous Mobile Robots and Process Control applications require an integration of traditional Expert system technologies with real-time response and control capabilities. To address such requirements, we propose an Asynchronous Production System (APS), which is a rule-based inference engine capable of monitoring and processing asynchronous, real-time information. The primary motivation of the proposed APS is to provide a unique and convenient mechanism for development of rule-based expert systems capable of dynamic and rapid interaction with their environments. This paper elaborates on the architectural, operational and implementational ramifications of Asynchronous Production Systems. To facilitate its description an example of an APS-based, distributed expert system is presented to handle the task of autonomous navigation in the presence of unexpected, moving obstacles in a mobile robot. 26 refs., 10 figs.

38996 **(CONF-880745—1) A comparison study of optimization methods for the bipartite matching problem (BMP).** Goldstein, M.; Toomarian, N.; Barhen, J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008092/JAW.

From IEEE annual international conference on neural networks; San Diego, CA, USA (24 Jul 1988).

A comparison study of optimization methods for the bipartite matching problem (BMP) with independent random distances between the points is presented. It is concluded that a variant of simulated annealing, developed at ORNL, is the most promising for the BMP. 8 refs., 1 fig., 1 tab.

38997 **(CONF-8608222—1) Algorithm design for high-performance computers.** Dongarra, J.J.; Sorensen, D.C. (Argonne National Lab., IL (USA)). 1986. Contract FG02-85ER25001;AC05-84OR21400;W-31109-ENG-38. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010038/JAW.

From IBM workshop on parallel computing; Oberleck, Austria (11 Aug 1986).

In this paper we look at two ways of constructing algorithms for parallel architectures. The first is based on taking well-understood algorithms and restructuring them to isolate simple, computationally intense modules. We then parallelize the well-defined modules for the specific architecture. In the second approach we develop new algorithms for parallel architectures. Our main emphasis is on algorithms for solving linear algebra problems where the software we develop would reside in a library on high-performance computers. We also discuss a software environment for developing parallel algorithms in Fortran. This environment provides for ease of program development, debugging, and algorithm understanding.

38998 **(CONF-8806149—1) Implementation of an OPS5 derivative on the Novix RISC processor.** Williams, L.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011392/JAW.

From Rochester forth conference; Rochester, NY, USA (14 Jun 1988).

The recent popularity of rule-based programming and reduced instruction set computer (RISC) architectures has made the marriage of these two technologies an almost inevitable alternative for applying artificial intelligence (AI) techniques to real-time computing tasks. This paper presents an overview of the software development environment for a rule-based expert-system language based on OPS5 that was written specifically for the Novix NC4016 CPU.

38999 **(CONF-8806154—1) Parallel implementation of the boundary element method.** Drake, J.; Gray, L.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011846/JAW.

From 2. international conference on vector and parallel computing: issues in applied research and development; Tromso, Norway (6 Jun 1988).

In this paper, the issues associated with the parallel implementation of the boundary element method (BEM) on a hypercube will be addressed. The program for solving the three dimensional Laplace equation is specifically adapted for electro-plating simulations; this application involves nonlinear boundary conditions and a time step iteration to follow the development of the plated surface. As a consequence, the coefficient matrices of the potential and normal derivative values are formed separately and stored. A step of the algorithm is thus required to combine and rearrange the system of equations into the standard form $AX = B$. The matrix A is dense and non-symmetric and recent advances in the solution of such systems on a hypercube are employed. Estimates of the arithmetic complexity at each step of the algorithm and a model for the communication costs are used to study the parallel performance of the BEM; timing results are presented for an implementation on an Intel iPSC2/d6 hypercube. The authors conclude that the BEM is particularly well suited for parallel solution and can be implemented efficiently on a hypercube.

39000 **(DOE/ER—0362) Federal Council on Science, Engineering and Technology: Committee on Computer Research and Applications, Subcommittee on Science and Engineering Computing: The US Supercomputer Industry.** (Office of Science and Technology Policy, Washington, DC (USA)). Dec 1987. 180p. NTIS, PC A09;3. Order Number DE88011262/JAW.

The Federal Coordinating Council on Science, Engineering, and Technology (FCCSET) Committee on Supercomputing was chartered by the Director of the Office of Science and Technology Policy in 1982 to examine the status of supercomputing in the United States and to recommend a role for the Federal Government in the development of this technology. In this study, the FCCSET Committee (now called the Subcommittee on Science and Engineering Computing of the FCCSET Committee on Computer Research and Applications) reports on the status of the supercomputer industry and addresses changes that have occured since issuance of the 1983 and 1985 reports. The review based upon periodic meetings with and site visits to supercomputer manufacturers and consultation with experts in high performance scientific computing. White papers have been contributed to this report by industry leaders and supercomputer experts.

39001 **(DOE/ER—0367) FASTBUS standard routines.** (USDOE Office of Energy Research, Washington, DC. High Energy Physics Div.). May 1988. 147p. NTIS, PC A07/MF A01;1; GPO Dep. Order Number DE88010337/JAW.

This document defines standard routines for software access to a FASTBUS system, a standardized modular high-speed data acquisition and control system defined in ANSI/IEEE Std. 960-1986,

published by the Institute of Electrical and Electronic Engineers. It is assumed that the reader is familiar with the FASTBUS system.

39002 **(DOE/ER/25009—522) What have we learnt from using real parallel machines to solve real problems?.** Fox, G.C. (California Inst. of Tech., Pasadena (USA)). Mar 1988. Contract FG03-85ER25009. 58p. (CONF-880117—5). NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88011227/JAW.

From 3. conference on hypercube concurrent computers and applications; Pasadena, CA, USA (19 Jan 1988).

We briefly review some key scientific and parallel processing issues in a selection of some 84 existing applications of parallel machines. We include the MIMD hypercube transputer array, BBN Butterfly, and the SIMD ICL DAP, Goodyear MPP and Connection Machine from Thinking Machines. We use a space-time analogy to classify problems and show how a division into synchronous, loosely synchronous and asynchronous problems is helpful. This classifies problems into those suitable for SIMD or MIMD machines and isolates the asynchronous class as that for which major uncertainties as to possible parallelism exist. Interestingly, about half of the scientific applications run excellently on SIMD machines with the other half able to take especial advantage of the MIMD architecture. 202 refs., 8 figs.

39003 **(DP-MS—88-92) Mobile robotics R & D at the Savannah River Laboratory.** Byrd, J.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1988. Contract AC09-76SR00001. 15p. (CONF-8806146—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011665/JAW.

From American Society for Engineering Education annual conference; Portland, OR, USA (21 Jun 1988).

The first teleoperated mobile vehicle was deployed at the Savannah River Plant in 1984 in response to a radioactive spill on the top of a large, outside waste storage tank. Based on the experience with teleoperators, a telerobotic vehicle for use in a wide range of nuclear applications is being developed. This research is briefly discussed and future research directions are touched upon.

39004 **(EGG-M—31887) The apocalypse of Western technology: Transforming American ingenuity into a resource of the Soviet state.** Revo, L.E.; Figelski, G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 19p. (CONF-880551—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007734/JAW.

From DOE computer security group conference; Kansas City, MO, USA (3 May 1988).

The purpose of this paper is to provide an overview of the threat facing the United States and other Westsern societies from the intelligence services of the Soviet Union and their surrogates among the Eastern European services. We will discuss some of their methodology for acquiring the high technology often lacking in the Soviet Union. We will also outline a basic Operations Security (OPSEC) program, that provides measures for increasing employee awareness of the threat and the consequences which can result from the loss or compromise of classified or sensitive information to those services.

39005 **(EUR—11291) Development and implementation of a pressure propagation code applicable in spherical geometry to euler/isentropic/acoustic modelling. Comparative treatment of shock-up and refection on simplified rigid or elastic obstacles.** Essers, J.A. (Liege Univ., Inst. de Mecanique (BE)). (Commission of the European Communities, Luxembourg). 1987. 92p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753958/JAW.

A sophisticated computer code for the calculation of plane or spherical pressure waves and their reflection on a simplified rigid or flexible obstacle has been constructed. Different options: choice of explicit or implicit scheme, use of eulerian, isentropic or acoustic flow models, introduction of different artificial viscosities, use of uniform or non-uniform adaptive grids have been made available and validated by simple shock waves computations. The results from different numerical experiments are presented. They have been used to evaluate the values of artificial viscosity coefficients leading to acceptable pressure pulses. In particular, the following important conclusions have been confirmed: - the linear acoustic model leads to important errors except for extremely weak overpressures; - an excellent accuracy can be obtained with the non-linear isentropic model in a wide overpressure range; - as opposed to the eulerian and to the non-linear isentropic models, the acoustic model is completely uncapable of predicting the shock-up phenomenon, and can therefore lead to important errors in the prediction of the pulse shape even for very weak overpressures.

39006 **(IAE—4288/4) TUBE-1 code for computerized simulation of stres-strain state and kinetics of the RBMK-1000 reactor.** Sergeeva, L.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701973/JAW.

TUBE 1 program permitting to perform calculated simulation of crack growth kinetics in tubes of RBMK-1000 technological channels with provision for initial residual strains in them has been developed for BESM-6 computer. Possibility of crack propagation according to a hydrogen embrittlement mechanism is investigated. Viscoelastic-plastic behaviour of tube material is taken account of in the process of high-temperature irradiation. Calculation of stress-strained state has been performed according to the finite elements method. 6 refs.; 3 figs.

39007 **(IAE—4400/15) Software of on-line system for calorimetric measurements. BASIC-L interpreter fast-acting.** Tanko, L.; Shikov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701981/JAW.

To exercize control over the automated system of data acquisition, processing and displaying, BASIC-L program package is developed which appears to be a fast-acting supplement to the original BASIC variant. Description of a fast-acting interpreter with a detailed presentation of its command syntax is given. BASIC-L structure is of modular character, i.e. it contains groups of commands with multiple parameters. Software, developed on the basis of a fastacting interpreter, is intended for calorimetric measurement automation. 4 tabs.

39008 **(IFT-P—32/87) Note on the Fermi-Dirac integral function.** Aguilera-Navarro, V.C.; Estevez, G.A.; Kostechki, A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702263/JAW.

A constructive method based on the bypass principle and the Pade approximation technique was used for deducing an implicit analytical expression for the Fermi-Dirac integral function. The simple equation has been found to be remarkably accurate in several fields of physics. (autor).

39009 **(JAERI-M—87-199) Proceedings of the forth seminar on software development in nuclear energy research.** Fujii, Minoru; Osugi, Toshitaka; Harada, Hiroo; Ise, Takeharu (eds.). (Japan Atomic Energy Research Inst., Tokyo). Nov 1987. vp. (In Japanese). (CONF-8709254—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88780073/JAW.

From 4. seminar on software in nuclear energy research; Tokai, Japan (9 Sep 1987).

Individual papers have been indexed separately. (WRF)

39010 **(JINR—R-10-87-130) Experimental data processing of the JINR nuclear recoil spectrometer on the SM-4 type minicomputer.** Gorshkova, N.L.; Denisenko, K.G.; Murin, Yu.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702182/JAW.

Approach to the processing of nuclear fragmentation data is considered. The possibility to simplify and accelerate data process-

ing on the basis of CM-4 (PDP - 11/34) computers is shown. This acceleration is due to the individual use of processor and peripherals and the simplicity of system software. The use of MES system and MDB software package for work with magnetic tapes with data and obtaining the cross sections for nuclear reaction products is described. 7 refs.; 6 figs.

39011 (JINR—R-10-87-152) Software of a spectrometer with a Ge(Li) detector on-line with the MERA-60/45 and PDP-11/70 computers. Description for users. Tumendemberel, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702183/JAW.

Software intended for processing spectrometric information in oder to study residual nuclear products produced at the fragmentation of atomic nuclei by relativistic nuclear beams of the synchrophasotron is described. The software consists of the following programs operating on the MERA-60/45 and PDP-11/70 computers: SUM, PDPS - for reception and preliminary processing of γ-ray spectra; SM1, SM2, SM3 - for express processing of spectra and nuclide identification. 8 refs.; 5 figs.

39012 (JINR—R-10-87-242) Subsystem for processing, storage and editing of the results of the chamber film scanning. Balgansurehn, Ya.; Dirner, A.; Ivanov, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702184/JAW.

A subsystem which is an element of the high-automated system for film data processing and intended for run with the scanning information is described. The subsystem consists of routines which allow to create, to edit and to print the file of scanning results both in batch and interactive mode on the CDC-6500 computer. 6 refs.

39013 (JINR—R-10-87-650) MULTI-FB histogramming program package for acquisition and analysis of spectrometric data on MERA-60 type microcomputer. Nikiforov, A.S.; Smirnov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702457/JAW.

The MULTI-FB system is a version a widely used MULTI program package on which base a software for a number of high energy physics spectrometers has been created. Structure and functioning of software of MULTI-FB system for automated systems and testing stands of electrophysical setups on the base of Mera-60 type microcomputer are described. A list of minimum set of apparatus for MULTI-FB system operation is given, commands of data reception language are described. 9 refs.; 1 fig.

39014 (K/CSD/INF—88/15) Improving software productivity: the selection and administration of GSA's programmers workbench at Martin Marietta Energy Systems, Inc. Verastegui, R.J.; Williams, D.J. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). May 1988. Contract AC05-84OT21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011803/JAW.

Improved software productivity is a vital concern to all data processing organizations. The Computing and Telecommunications Division (C & TD) of Martin Marietta Energy Systems, Inc., is in the process of developing a long-term strategy for software management that has as its major goal the improvement of software productivity. As this strategy evolves, C & TD will evaluate a number of concepts, including software life-cycle methodologies, computer-aided software engineering (CASE) tools, programmers' workbenches, and libraries of reusable software modules. This report focuses on only one of these areas, the programmers' workbench concept. A programmers' workbench links a variety of software productivity tools under one structure. During recent months, C & TD evaluated a workbench available through the General Services Administration (GSA). This product is targeted for the management of existing IBM MVA COBOL application systems. Our experiences with this product have been largely positive, and we intend to use the product as a key component of our overall software management program. This report addresses our experiences with the product to date and our plans for using it in the future.

39015 (LA—11252-MS) Analytical and experimental studies of ventilation systems subjected to simulated tornado conditions: Verification of the TVENT computer code. Martin, R.A.; Gregory, W.S.; Ricketts, C.I.; Smith, P.R.; Littleton, P.E.; Talbott, D.V. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 105p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010482/JAW.

Analytical and experimental studies of ventilation systems have been conducted to verify the Los Alamos National Laboratory TVENT accident analysis computer code for simulated tornado conditions. This code was developed to be a user-friendly analysis tool for designers and regulatory personnel and was designed to predict pressure and flow transients in arbitrary ventilation systems. The experimental studies used two relatively simple, yet sensitive, physical systems designed using similitude analysis. These physical models were instrumented end-to-end for pressure and volumetric flow rate and then subjected to the worst credible tornado conditions using a special blowdown apparatus. We verified TVENT by showing that it successfully predicted our experimental results. By comparing experimental results from both physical models with TVENT results, we showed that we have derived the proper similitude relations (governed by compressibility effects) for all sizes of ventilation systems. As a by-product of our studies, we determined the need for fan speed variation modeling in TVENT. This modification was made and resulted in a significant improvement in our comparisons of analytical and experimental results.

39016 (LA-UR—88-1166) Building an artificial intelligence capability at Los Alamos. Marinuzzi, J.G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-880393—1). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009155/JAW.

From Artificial intelligence applications for military logistics conference; Williamsburg, VA, USA (29 Mar 1988).

In 1985, after three years of preliminary work, Management of the Los Alamos National Laboratory started an ambitious program to develop a strong technical capability in the rapidly emerging field of Artificial Intelligence/Knowledge Based Systems (AI/KBS). When this AI development program began, except for a few staff members doing basic AI research, AI was essentially nonexistent at the laboratory. The basics, including such things as AI computer hardware and software, literature, books, knowledgeable personnel, or even a general knowledge of what AI was, were most difficult if not impossible to find. For this reason, we had to approach the problem with a very broad perspective, which strongly addressed the basics while aiming toward more advanced AI program elements. Broad, intensive education was the "bootstrapping" tool used in this five year, multi-million dollar AI capability development program. Halfway through the program, our accomplishments indicate that the program is extremely successful. In terms of trained staff, active programs and "state-of-the-art equipment," we have developed one of the strongest AI technical capabilities within the Department of Energy (DOE) and the Department of Defense(DOD). However, a great deal more must be done before the full potential of the program can be realized. 1 fig.

39017 (LA-UR—88-1736) Techniques for developing reliable and functional materials control and accounting software. Barlich, G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 4p. (CONF-880631—3). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010926/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The media has increasingly focused on failures of computer systems resulting in financial, material, and other losses and on systems failing to function as advertised. Unfortunately, such failures with equally disturbing losses are possible in computer systems providing materials control and accounting (MC&A) functions. Major improvements in the reliability and correctness of systems are possi-

ble with disciplined design and development techniques applied during software development. This paper describes some of the techniques used in the Safeguard Systems Group at Los Alamos National Laboratory for various MC&A systems. 9 refs.

39018 **(LBL—23597) Using common subexpressions to optimize multiple queries.** Park, J.; Segev, A. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 10p. (CONF-880245—2). NTIS, PC A02;3. Order Number DE88008210/JAW.

From 4. international conference on data engineering; Los Angeles, CA, USA (1 Feb 1988).

This paper deals with the problem of identifying common subexpressions and using them in the simultaneous optimization of multiple queries. In particular, we emphasize the strategy of selecting access plans for the single queries and their integration into a global access plan that takes advantage of common tasks. We present a dynamic programming algorithm for the selection of individual access plans such that the resulting global access plan is of minimum processing cost. The computational complexity of this algorithm represents a significant improvement over existing algorithms. 25 refs., 11 figs.

39019 **(NUREG/CR—5044) Estimation techniques for common cause failure events.** Kelly, E.J.; Hemphill, G.M. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 50p. (LA—11179-MS). NTIS, PC A03/MF A01 - GPO;1. Order Number TI88011214/JAW.

Common cause failure probability estimation techniques, including β-factor basic parameter, binomial failure rate, multiple Greek, and C-factor estimators, are evaluated and compared using simulation data that captures the real world problem of sparse data from different plants. The effects on the estimators' performances from underlying factors such as common cause shock rates, lethal shock rates, probability of failing given a shock, independent failure rates, and system operational time are discussed. Worst case results are reported, and it is seen that for extremely small common cause failure probabilities the binomial failure rate estimators are best. However, these estimators can underestimate the true probabilities when the failured deviate from the binomial failure rate mode. The β-factor technique is shown to be conservative, and in some cases to overestimate the true probability by several orders of magnitude. When there are observed failutes for each failure event, the basic parameter technique is best and is easily calculated. This estimator is investigated in detail and is used to develop an estimator for the probability of K or more units failing due to a common cause. Uncertainty limits for this probability are also developed.

39020 **(PB—88-192471/XAB) Scheme for translating control flow in the C programming language to Grafcet with examples.** Thomas, B.H. (National Bureau of Standards, Washington, DC (USA)). Mar 1988. 31p. (NBSIR—88/3741). NTIS, PC A03/MF A01.

The purpose of the paper is to show a translation scheme from control flow in the C programming language to the Grafcet language. Grafcet is a graphical language for expressing control flow. Grafcet is used to design parallel systems such as in a manufacturing environment. The control constructs covered in the paper are: conditional statement; while; do; for; switch; break; continue; goto; label; and null. The Grafcet used in the paper is the language, as augmented by Savoir. The C programming language is the one described by Kernighan and Ritchie. The translation is to be used as a reference for programmers to translate existing C source code into Grafcet.

39021 **(SAND—88-0262C) Factorization of large integers on a massively parallel computer.** Davis, J.A.; Holdridge, D.B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-8805114—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011625/JAW.

From Eurocrypt '88; Davos, Switzerland (25 May 1988).

Our interest in integer factorization at Sandia National Laboratories is motivated by cryptographic applications and in particular the security of the RSA encryption-decryption algorithm. We have implemented our version of the quadratic sieve procedure on the NCUBE computer with 1024 processors (nodes). The new code is significantly different in all important aspects from the program used to factor number of order 10^{70} on a single processor CRAY computer. Capabilities of parallel processing and limitation of small local memory necessitated this entirely new implementation. This effort involved several restarts as realizations of program structures that seemed appealing bogged down due to inter-processor communications. We are presently working with integers of magnitude about 10^{79} in tuning this code to the novel hardware. 6 refs., 3 figs.

39022 **(SAND—88-0451) Maximum entropy signal restoration with linear programming.** Mastin, G.A.; Hanson, R.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011740/JAW.

Dantzig's bounded-variable method is used to express the maximum entropy restoration problem as a linear programming problem. This is done by approximating the nonlinear objective function with piecewise linear segments, then bounding the variables as a function of the number of segments used. The use of a linear programming approach allows equality constraints found in the traditional Lagrange multiplier method to be relaxed. A robust revised simplex algorithm is used to implement the restoration. Experimental results from 128- and 512-point signal restorations are presented.

39023 **(SAND—88-0896) TRINITY II: A post-processing program for two-dimensional finite element analysis data.** Glick, J.H.; Gartling, D.K. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 70p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010107/JAW.

TRINITY II is a program for post-processing data from two-dimensional finite element analyses. The program provides graphical display of mesh and solution data as well as data manipulation, file editing and selective printing of data. TRINITY II accepts data from any analysis code that employs the EXODUS file format; post-processing can be done interactively or in batch mode using any graphics device supported by the Sandia Virtual Device Interface. The capabilities and use of the program are described. 4 refs.

39024 **(SAND—88-0952) A comparison of generators for pseudo-random normal deviates.** DeLaurentis, J.M.; Boughton, B.A. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011711/JAW.

Stochastic models of physical systems often require the generation of a large number of normally distributed random numbers. This investigation studies three different algorithms for generating pseudo-random normal deviates: a method based on the Central Limit Theorem, the polar method and the ratio method. These techniques were chosen because they provide portable generators that are easily implemented in any higher-level programming language. This report shows that all three methods produce reliable statistics, but that the polar method is considerably faster. 3 refs., 1 fig.

39025 **(SAND—88-1420C) Zero-knowledge proofs of identity and veracity of transaction receipts.** Simmons, G.J.; Purdy, G.B. (Sandia National Labs., Albuquerque, NM (USA); Cincinnati Univ., OH (USA). Dept. of Mathematics). 1988. Contract AC04-76DP00789. 15p. (CONF-8805114—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010576/JAW.

From Eurocrypt '88; Davos, Switzerland (25 May 1988).

There are two equally important, related, functions involved in the control of assets and resources. One of these is the verification of a potential user's identity and authority to use or have access to those assets. The other is to provide a record (receipt) of each access so that in the event of a later dispute as to whether an illegitimate use was made of the assets, or of the extent of the liability incurred in a legitimate use, etc., the authenticity and specifics of the access can be demonstrated in a logically compelling (and

hence eventually legally binding) manner to an impartial third party or arbiter. Elaborate, and legally accepted, document based protocols to accomplish these functions are central to all commercial and private transactions. When the resources are remotely accessible, however, as in the case of computer data files, electronic funds transfers (EFT), automated bank tellers, and even in many manned point-of-sale systems, no satisfactory counterpart to the established document based protocols for verifying individual identity and/or authority to use a resource have been found, nor has a fully satisfactory means been devised to provide unforgeable transaction receipts. In this paper, we show how a public authentication channel can be used to certify private (user unique) authentication channels in a protocol that both "proves" a potential user's identity and authority and also provides certified receipts for transactions whose legitimacy can later be verified by impartial arbiters who did not have to be parties to the original transaction. 22 refs.

39026 (SRD-R—369) Recent improvements in CRACUK modelling. Egan, M.J.; Nixon, W. (UKAEA Safety and Reliability Directorate, Culcheth). Aug 1986. 15p. UKAEA Safety and Reliability Directorate, Culcheth. Order Number TI88100002/JAW.

The CRACUK codes is a revised version of the US Consequence modelling code CRAC2, adapted to suit UK applications. This report describes in detail the modifications to the dosimetric models contained within the code, and assesses their influence upon the predicted consequences of postulated atmospheric releases following severe light water and fast reactor accidents. The impact for such source terms is not marked, when compared with existing uncertainty bands, although, for the fast reactor case, the distribution of predicted cancers among the different types is significantly affected. Nevertheless, the improvements lend confidence to the use of CRACUK for the assessment of accidents for a wider range of nuclear plant.

39027 (UCID—21383) Praxis release notes: Version 7.9. Holloway, F.W. (Lawrence Livermore National Lab., CA (USA)). 7 Apr 1988. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88009538/JAW.

These release notes are intended as a guide to those responsible for Nova software and users of Praxis at other organizations. They assume previous knowledge of the Praxis language. All improvements and revisions made in this version of Praxis are described.

39028 (UCID—30207-Rev.2) The inter-authentication-domain (IAD) logon protocol (Preliminary specification and implementation guide). Nessett, D.M. (Lawrence Livermore National Lab., CA (USA)). 6 May 1988. Contract W-7405-ENG-48. 64p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010732/JAW.

With the development of computer networking, it has become desirable for users to interact with hosts and distributed operating systems from terminals not directly connected to those systems. Users and the institutions for which they work require distributed interactive services to take advantage of specialized software and hardware as well as economically priced computing capacity. A classical example of this requirement occurs in the ARPANET and it is becoming more widespread as local networks are interconnected. As discussed below, the problem of providing distributed interactive services is complicated by the heterogeneity of the systems involved. This heterogeneity is a characteristic of both the systems themselves as well as of the protocols they support. The general problems of interconnecting such systems have been previously investigated from the perspective of providing distributed interprocess communication [CEKA74,SUNC77]. The framework, the widely used terms internetwork and internetwork system of internetwork node will be used to refer to the heterogeneous environment under discussion. Heterogeneity is only one aspect of the distributed interactive services problem. The variety of situations in which distributed interactive services are required, operational requirements, security considerations, and human-factors requirements also play major roles in defining the exact nature of the problem. 29 refs., 8 figs.

39029 (UCRL—96744) The sub-implicit method: New multiprocessor algorithms for old implicit codes. Eltgroth, P.G.; Seager, M.K. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 12p. (CONF-8708148—4). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011345/JAW.

From Vector and parallel processing in computational science; Liverpool, UK (25 Aug 1987).

This paper presents a new approach to the parallel solution of an implicit system of difference equations. The sub-implicit method operates on sub-regions of the data which are evaluated at spatial points and synchronous time. Each sub-region has a border node which is shared with an adjacent sub-region (in one dimension). Values for this shared node are computed independently by the two solution processes for two adjacent sub-regions. Nodes outside the sub-region are treated as having fixed values during the solution. At the finish of the two sub-region solutions, the two sub-regions are blocked against further changes (a pairwise synchronization) and the two different values for the shared node are reconciled. This can be done in such a way that energy conservation is exact. Results for test problems for heat diffusion in one dimension are given and compared against standard methods and analytic results. Implementation of the method into a demonstration two dimensional hydrodynamics code SIMPLE is described. The best speedups observed for parallel execution of this version of SIMPLE on a twelve cpu Sequent multiprocessor were 9.6 for a 50 by 50 grid and 10.4 for a 95 by 95 grid. Some generalizations of this approach are discussed. 4 refs., 4 figs.

39030 (UCRL—97414) A systolic array for efficient execution of the Faddeev Algorithm. De Groot, A.J.; Johansson, E.M.; Parker, S.R. (Lawrence Livermore National Lab., CA (USA)). 24 Sep 1987. Contract W-7405-ENG-48. 9p. (CONF-8708110—37; CONF-8708110—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011330/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

The Systolic Processor with a Reconfigurable Interconnection Network of Transputers (SPRINT) is a sixty-four-element multiprocessor developed at Lawrence Livermore National Laboratory to evaluate systolic algorithms and architectures experimentally. The processors are interconnected in a reconfigurable network which can emulate networks such as the two-dimensional mesh, the triangular mesh, the trapezoidal mesh, the tree, and the shuffle-exchange network. The SPRINT's computation capability surpasses its communication capability. Techniques have been developed to perform the Faddeev Algorithm utilizing most of its computing capability by operating on block matrices. These techniques reduce communication bandwidth requirements for a given computation rate and increase efficiency to close to 100%. The Faddeev algorithm calculates the quantity $CX + D$, where X is the solution to $AX = B$, and where A, B, C, and D are given. All quantities are square matrices. Several linear algebra operations such as the matrix-matrix product and matrix inversion can be calculated by loading appropriate values for A, B, C, and D. The Faddeev algorithm is executed on the SPRINT to compare theory with experiment. 7 refs., 4 figs.

39031 (UCRL—97872) A menu-driven menu editor and associated menu system. Preckshot, G.G.; Butner, D.N. (Lawrence Livermore National Lab., CA (USA)). 18 Feb 1988. Contract W-7405-ENG-48. 17p. (CONF-880364—16). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008026/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

A menu-style user interface has been developed at Lawrence Livermore National Laboratory (LLNL) for distributed control, data acquisition and data processing. A graphical menu editor, which is itself the first application of the menu system, is used to construct or modify menu hierarchies. Unlike many menu systems, no code need be written to demonstrate a set of menus because there are no subroutine calls to make menus; developers need only write the code which performs the actions indicated by user menu picks. In addition to this rapid prototyping feature, the menu

system is integrated with operating system asynchronous traps (in Unix, signals and selects) so that it supports real-time user interfaces for control in a distributed computer system. 4 refs., 3 figs.

39032 **(UCRL—97921) An expert system for automating security incident assessment using OPS5 in an Ada environment.** Canales, T.W.; Smart, J.C. (Lawrence Livermore National Lab., CA (USA)). 29 Jan 1988. Contract W-7405-ENG-48. 9p. (CONF-880464—2). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88011734/JAW.

From Applications of artificial intelligence conference; Orlando, FL, USA (4 Apr 1988).

An expert system that automatically assesses security incidents is being developed at Lawrence Livermore National Laboratory. The expert system associates, classifies, and prioritizes monitored sensor events. The outcome of these processes is a dynamic representation of the state of Laboratory security in the form of security "incidents". A graphical representation of the incidents is integrated into a map-oriented console monitor that provides the operator with a comprehensive view of incidents and their locations. A prototype expert system has been developed using the OPS5 rule-based language. A large Ada-based program provides control of the map display system and interfaces to the various monitoring and access-control devices. In addition to the expert system operation, the issues and methods involved in integrating the OPS5-based incident-assessment system to the large Ada-based control program are discussed. 7 refs., 7 figs.

39033 **(UCRL—97980-Rev.1) On the implementation of applicative languages on shared-memory, MIMD multiprocessors.** Lee, Ching-Cheng; Skedzielewski, S.; Feo, J. (Lawrence Livermore National Lab., CA (USA)). 27 Apr 1988. Contract W-7405-ENG-48. 10p. (CONF-880731—1-Rev.1; CONF-880731—). NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88009823/JAW.

From Computing machinery sigplan symposium: experience with applications, languages and systems; New Haven, CT, USA (19 Jul 1988).

This paper presents the performance of a set of algorithms written in SISAL [MSA*85] and run on multiprocessor Sequent, DEC, and Cray computers. We describe our current runtime system and discuss its implementation on each machine. We indicate where our automatic approach to parallelization works well, as well as sources of inefficient behavior. Overall we find our systems encouraging for the first release of the native-code generating software. We suggest improvements to the compiler and runtime systems, many already developed but not yet implemented, to alleviate the inefficiencies. 12 refs., 3 figs., 3 tabs.

39034 **(UCRL—98638) A fast vortex code for computing 2-D flow in a box.** Baden, S.B.; Puckett, E.G. (Lawrence Livermore National Lab., CA (USA)). 29 Jun 1988. Contract W-7405-ENG-48;AC03-76SF00098. 21p. (CONF-880716—6). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88011732/JAW.

From 1. national fluid dynamics congress; Cincinnati, OH, USA (24 Jul 1988).

We present a fast, accurate hybrid vortex method for computing incompressible, viscous flow at large Reynolds numbers in a two-dimensional bounded domain. The random vortex method is used to model the flow away from the boundary and the vortex sheet method is used to model the flow near boundary. Our implementation of these methods exploits the localized nature of interactions among vortex elements in each of the respective regions of the domain. A local corrections approximation is used to accelerate the velocity computation in the interior. It is substantially faster than other methods of comparable accuracy and can economically handle tens of thousands of vortex elements. We evaluate the method on the flow in a box due to a central stationary vortex. The running time for this problem is rougly linear in the number of vortex elements and results are in good qualitative agreement with other numerical solutions of the same problem.

39035 **(WAPD-TM—1619) TRANSL: A PATRAN translator subroutine library.** Butler, K.M.; Caldwell, C.S. (ed.). (Bettis Atomic Power Lab., West Mifflin, PA (USA)). May 1988. Contract AC11-76PN00014. 54p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010976/JAW.

The TRANSL subroutine library enables a programmer to easily interface and translate engineering models developed using PATRAN interactive graphics software to engineering analysis computer programs, typically executed on large mainframe computers. PATRAN is a powerful program which greatly simplifies the tasks of generating two- or three-dimensional geometry models, creating finite element grids, and applying boundary conditions. In order to use a model created in PATRAN in any analysis program, a translator must be written to convert the model from the PATRAN neutral file format into an input format specific to the analysis program. TRANSL is a versatile FORTRAN-77 subroutine library implemented on VAX computers which performs activities common to any interactive PATRAN translator. Its capabilities include reading specified PATRAN neutral file data into memory, sorting neutral file data and general arrays, searching for a specific piece of information, communicating with the user, and file handling. A session file for automatic submission of input in a later translator session and a print file containing all communication with the user may be automatically generated. The driver for the TRANSL subroutine library is a program which reads all data from the neutral file into memory and writes it out again in the same format. This program demonstrates the use of TRANSL subroutines for developing a PATRAN translator and provides a means for testing the TRANSL subroutines. 4 refs.

39036 **(WAPD-TM—1620) PATFID: A translator from PATRAN to FIDAP.** Butler, K.M.; Caldwell, C.S. (ed.). (Bettis Atomic Power Lab., West Mifflin, PA (USA)). May 1988. Contract AC11-76PN00014. 73p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88010977/JAW.

PATFID is an interactive program which translates a model developed in the interactive graphics program PATRAN into an acceptable format for the fluid dynamics program FIDAP. The engineer wishing to analyze a problem in fliud flow or heat conduction first uses PATRAN top create a finite element model consisting of nodes, elements, and boundary conditions, following the instructions provided in this manual. The PATRAN neutral file containing this model is then supplied to PATFID, which prompts the user for all additional information needed for FIDAP. The specific questions that the user is asked depend upon the nature of the model developed in PATRAN and upon answers to previous questions. A print file, containing all messages to and from the user, and a session file, which can be used to supply user responses in a later run, are automatically generated by PATFID. The output file from PATFID is a complete and internally consistent input file for the FIDAP pre-processor FIPREP. PATFID is a FORTRAN-77 program implemented on VAX computers. It will translate any neutral file appropiate for FIDAP created by any version of PATRAN at least up to 2.0 into the FIPREP input file for Version 3.0 of FIDAP. Fluid problems which can be prepared for FIDAP using PATFID include two- and three-dimensional problems with pressure, heat flux (including radiative and convective flux), velocity, and temperature boundary conditions and velocity and temperature initial conditions. PATFID utilizes subroutines from the TRANSL subroutine library for PATRAN translators. 8 refs., 5 figs., 0 tabs.

39037 **(Y/DW—772) Computer integrated manufacturing implementation at the Oak Ridge Y-12 Plant: The sixth year of a ten-year plan.** Bowers, G.L.; Harper, H.E. (Oak Ridge Y-12 Plant, TN (USA)). 7 Oct 1987. Contract AC05-84OR21400. 12p. (CONF-880486—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88008222/JAW.

From Automated manufacturing exhibition and conference; Greenville, SC, USA (12 Apr 1988).

The strategic and operational plans for the computer integrated manufacturing (CIM) program in the Y-12 Plant are providing for the evolution of the plant's CIM infrastructure from today's environment to the integrated, highly flexible, and more responsive manufacturing systems planned for the 1990s. The program is committed to meeting the CIM directives established by the US Department of Energy and providing the means by which operations

can improve the manufacturing performance of the Y-12 Plant. The plant's CIM program charter is a commitment to coordinating efforts to implement and integrate CIM technologies to improve manufacturing performance and thus significantly enhance the plant's ability to meet current and future manufacturing objectives. To achieve these objectives, CIM technologies are being applied to automate manufacturing processes and information systems. 1 ref., 1 fig.

39038 **Predicting multiprocessing efficiency on the Cray multiprocessors in a (CTSS) time-sharing environment/application to a 3-D magnetohydrodynamics code.** Mirin, A.A. (National Magnetic Fusion Energy Computer Center, Lawrence Livermore National Laboratory, P. O. Box 5509, L-561, Livermore, California 94550). *Computers in Physics;* **2**: No. 4, 62-67(Jul 1988).

A formula is derived for predicting multiprocessing efficiency on Cray supercomputers equipped with the Cray Time-Sharing System (CTSS). The model is applicable to an intensive time-sharing environment. The actual efficiency estimate depends on three factors: the code size, task length, and job mix. The implementation of multitasking in a three-dimensional plasma magnetohydrodynamics (MHD) code, TEMCO, is discussed. TEMCO solves the primitive one-fluid compressible MHD equations and includes resistive and Hall effects in Ohm's law. Virtually all segments of the main time-integration loop are multitasked. The multiprocessing efficiency model is applied to TEMCO. Excellent agreement is obtained between the actual multiprocessing efficiency and the theoretical prediction.

39039 **Realizing fault-tolerant interconnection networks via chaining.** Tzeng, N.F.; Yew, P.C.; Zhu, C.Q. (Center for Advanced Computer Studies, Univ. of Southwestern Louisiana, Lafayette, LA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Computers;* **37**: No. 4, 458-462(Apr 1988).

A scheme applicable to a wide class of multistage interconnection networks to enhance their fault-tolerant capability is proposed. Multiple paths between each input-output pair of a network are created by connecting together switching elements within the same state. This scheme provides a network with alternative paths at every stage, requires a simple self-routing algorithm, and allows a network to become more robust as its size increases. An analysis is performed to obtain a quantitative measurement on the reliability improvement of the scheme.

39040 **A new technique for solving nonlinear differential equations encountered in modeling of neuroreceptor-binding ligands.** Huang, S.C.; Bahn, M.M.; Phelps, M.E. (Div. of Nuclear Medicine and Biophysics, Dept. of Radiological Sciences, and Dept. of Biomathematics, UCLA School of Medicine (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 762-766(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

For assessing neuroreceptor density with positron emission tomography (PET), nonlinear differential equations consisting of products of the tracer concentrations are needed to describe the tracer kinetics of receptor binding ligands. The authors have investigated an iterative solution technique for this type of nonlinear differential equations. The technique involves solving iteratively a sequence of linear differential equations that is related to the original nonlinear differential equation. The sequence of solution of these linear differential equations converges to the solution of the nonlinear differential equation. The technique is faster and more accurate than Runge-Kutta numerical integration technique. The solution technique can facilitate the investigation of the tracer kinetic characteristics of neuroreceptor-binding ligands and the estimation of neuroreceptor density from PET collected kinetics of receptor-binding ligands.

39041 **Overview of robotics at Los Alamos National Laboratory.** Knobeloch, D.W. (Los Alamos National Lab., NM (USA)). pp vp of 194th national meeting of the American Chemical Society, Division of Analytical Chemistry Newsletter. Washington, DC; American Chemical Society (1987). (CONF-8708245—).

From American Chemical Society Division of Analytical Chemistry meeting; New Orleans, LA, USA (30 Aug 1987).

The Robotics Section of the Mechanical and Electronic Engineering Division has a programmatic effort to implement robotics and automation at Los Alamos National Laboratory. The primary objective is to apply robotics to select areas of nuclear materials handling and processing operations. The overriding impetus is the reduction of low-level radiation exposure to operating personnel. These goals are being realized by employing industrial and laboratory robots to develop automation and robotic systems to process nuclear materials. Since the robotics industry focuses on major production markets, the nuclear industry related problems such as equipment sized for glovebox operation, construction materials that are radiation and corrosion resistant, and determining which systems will operate in corrosive and/or inert atmospheres need to be addressed. The Robotics section has realized several of these major goals and is now beginning to apply robotic technology to other research efforts at Los Alamos. These new initiatives include: the design of a custom gantry robot; automation of molecular biology processes in support of the Human Genome Project; use of artificial intelligence and knowledge based systems; automation and robotics for the planned Space Station mission; and other areas of research and development.

39042 **Numerical resolution of front phenomena by regridding techniques.** Degreve, J.; Dimitriou, P.; Puszynski, J.; Hlavacek, V.; Valone, S.; Behrens, R. (Dept. MST-3, Los Alamos National Lab., Los Alamos, NM (US)). pp 376-403 of Supercomputer research in chemistry and chemical engineering. Jensen, K.F.; Truhlar, D.G. Washington, DC; American Chemical Society (1987). (CONF-8703229—).

From Symposium on supercomputer research in chemistry and chemical engineering; Minneapolis, MN, USA (16 Mar 1987).

Solutions to models with different length scales may contain regions such as shocks, steep fronts, and other near discontinuities. Adaptive meshing strategies, in which a spatial mesh network is adjusted dynamically so as to capture the local behavior accurately, are described. The algorithm is tested on an example of filtration combustion.

9903 Information Handling

REFER ALSO TO CITATION(S) 37260, 37407, 38263, 38517, 38966, 38973, 38987, 39018

39043 **(AD-A—190305/3/XAB) Expert-system enhancement to the resource-allocation modules of the NCS Emergency Preparedness Management Information System (EPMIS). Final report.** (Delta Information Systems, Inc., Horsham, PA (USA)). Jan 1987. 196p. NTIS, PC A09/MF A01.

Availability: Document partially illegible.

This document summarizes work performed by Delta Information Systems, Inc., for the Office of Technology and Standards of the National Communications System, an organizations of the U.S. Government, under Contract number DCA100-86-C-0099. The Office of Technology and Standards, headed by National Communications System Assistant Manager Dennis Bodson, is responsible for the development of advanced technology for the NCS. The Office of the Manager, NCS requires timely, accurate information about the status of communications resources during national emergencies and declared disasters. This led to the realization that an automated decision support system would be useful to NCS Emergency Management Teams, which play a significant role in the monitoring and resolution of such situations. The Emergency Preparedness Management Information System (EPMIS) is an integral part of the National Emergency Telecommunications Management System, which is designed to allow the Manager, National Communications System (NCS) to respond to declared national emergencies.

39044 **(AD-A—190350/9/XAB) NATO Scientific and Technical Information Service (NSTIS): functional description. Final report.** Molholm, K.N.; Blados, W.N.; Bulca, C.; Cotter, G.A.; Cuffez, A. (Defense Technical Information Center, Alexandria, VA (USA). Office of Information Systems and Technology). Aug 1987. 173p. (DTIC/TR—88/6). NTIS, PC A08/MF A01.

This report provides a functional description of the requirements for a NATO Scientific and Technical Information Service (NSTIS). The user requirements and much of the background information in this report were derived primarily from interviews with more than 60 NATO Headquarters staff members between 2 March and 25 March 1987. In addition, representatives of the Supreme Headquarters Applied Powers Europe (SHAPE) Technical Centre (STC), the Supreme Allied Commander Atlantic (Anti-Submarine Warfare Research) Centre (SACLANTCEN), the NATO Communications and Information Systems Agency (NACISA), The Advisory Group for Aerospace Research and Development (AGARD), the U.S. Defense Technical Information Center (DTIC), and the Technical Documentation Center for the Armed Forces in the Netherlands (TDCK), were interviewed, either in person or by telephone.

39045 **Wide band data transmission system using optical fibers.** Leskovar, B.; Nakamura, M.; Turko, B.T. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 334-341(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

An ultra high speed data transmission system using optical fibers and gallium arsenide digital integrated circuits has been investigated. The system is designed to meet the increased data rate requirements of modern information processing systems as well as those of future imaging devices and high spatial resolution detectors. A description of the system which uses available components made for the transmission and reception of data at 780 Mbit/s rates is given. Methods for digitizing, multiplexing, demultiplexing, error checking, etc. are also described, and a discussion of the reliability of components is presented.